ELECTRICAL REVIEW

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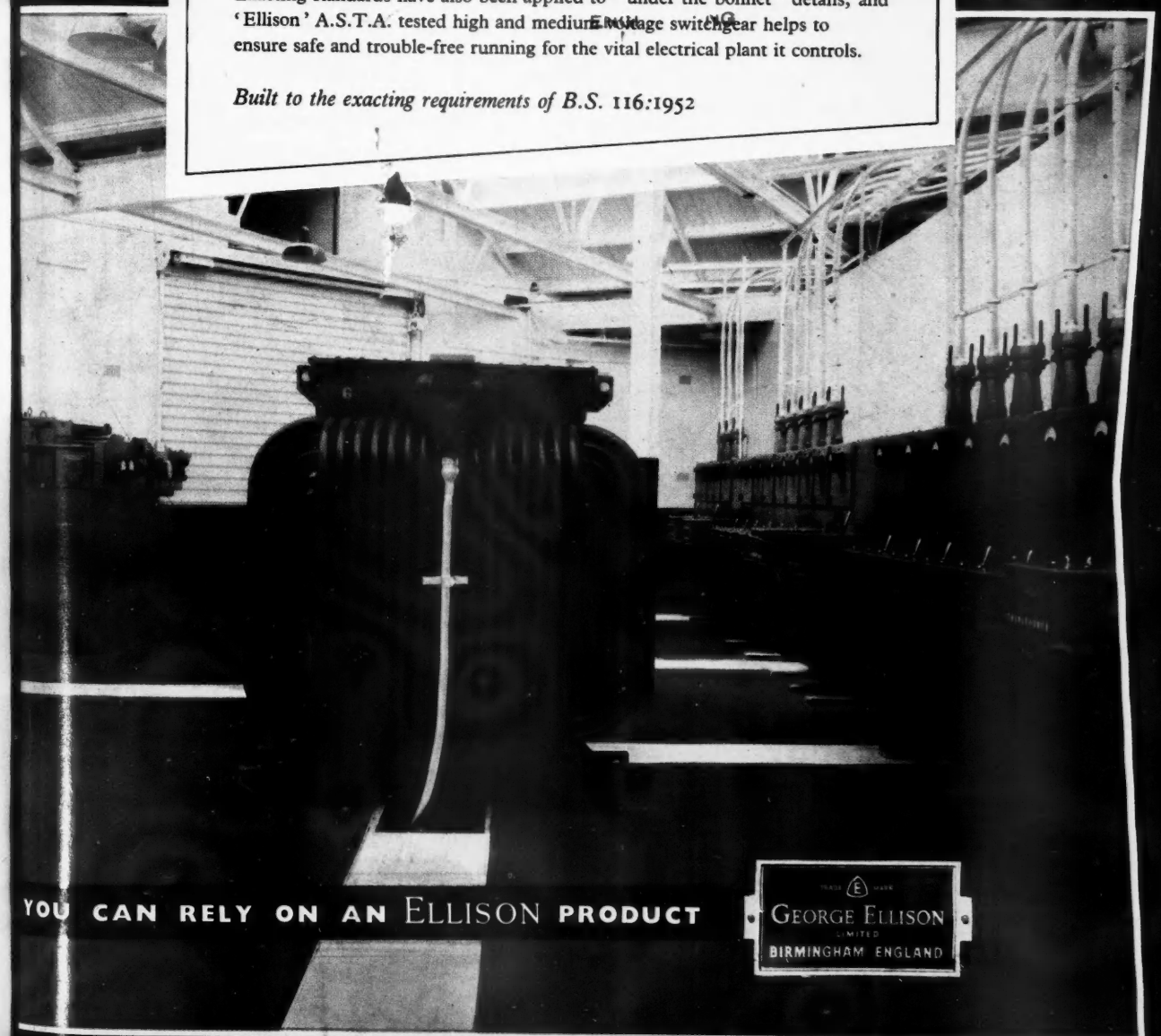

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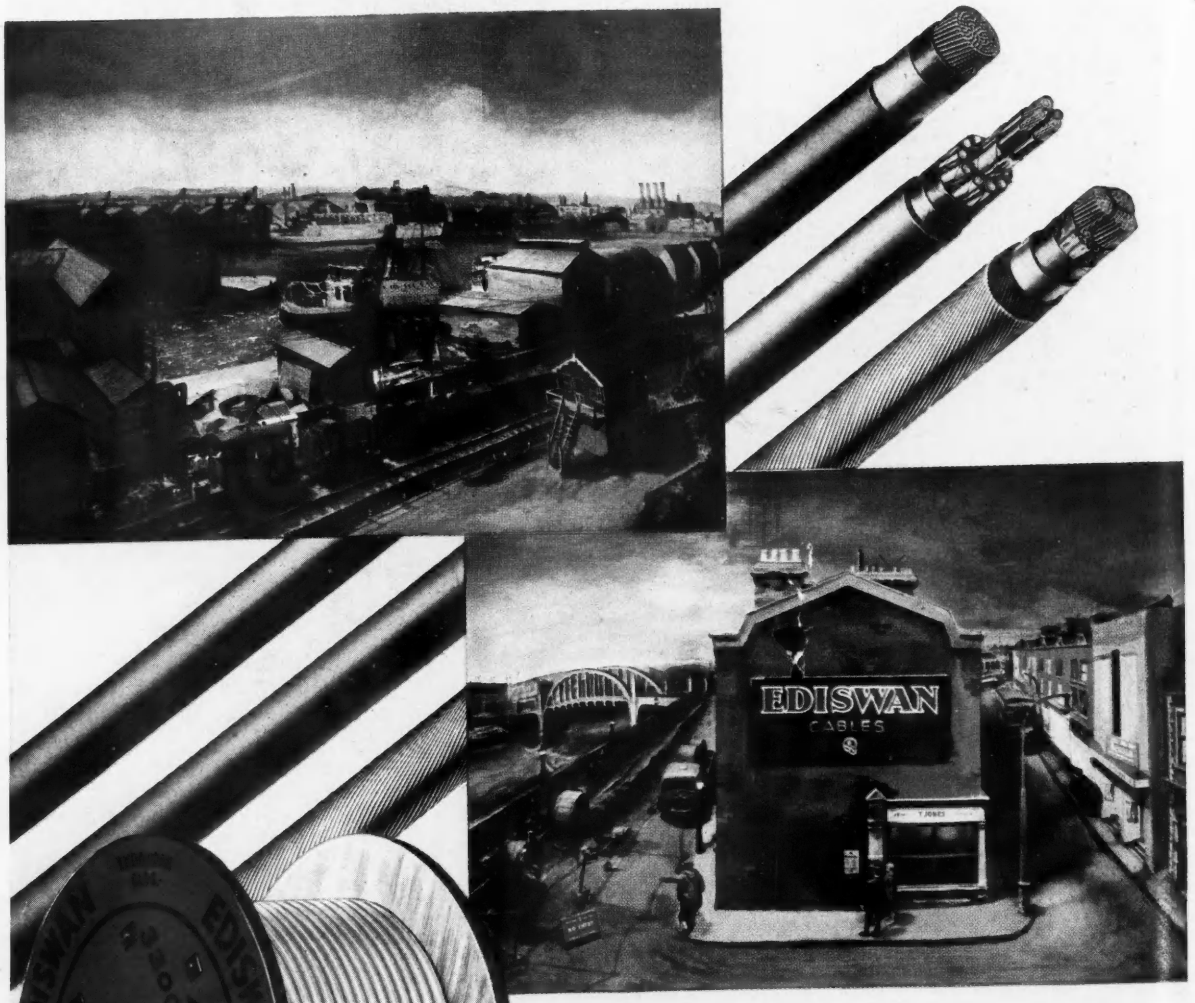

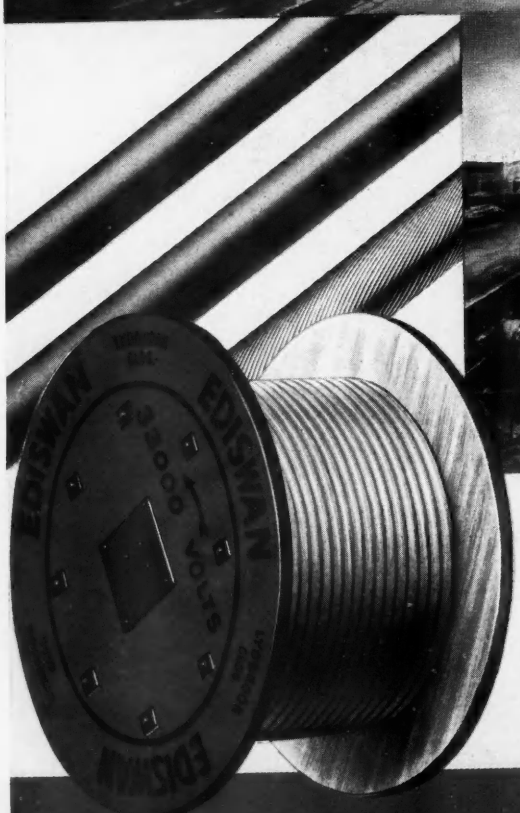

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ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E.
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30 SEPTEMBER 1955

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THE Report of the British Productivity Council on FUEL CONSERVATION stressed the enormous wastage of fuel in industrial plants in this country, and emphasized the urgent need —and the possibilities—of greatly increased efficiency in the use of fuel.

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ELECTRICAL REVIEW

30 September 1955 Vol. 157 No. 14 Established 1872

Electricity Supply Progress

THE Report of the British Electricity Authority for 1954–55 published this week and reviewed on a later page shows that that year satisfactorily concluded the seven years of the B.E.A. under that designation. The increase over the previous twelve months in the number of kWh generated has been exceeded only once since vesting day and the annual improvement in fuel economy has been well sustained. The capacity of generating plant installed was the greatest yet. Nevertheless the one power cut necessary occurred last October, indicating that the margin of kilowatts to allow for plant overhaul was still precarious.

Three power stations again passed 30 per cent thermal efficiency, including Littlebrook " B " which headed the list two years ago at a lower efficiency; this station and the scheme of operation in conjunction with its associated " A " and " C " stations was described in our issue of 1st January. The six new stations which started to generate last year have formed the subject of articles in this journal in recent weeks. Work on the construction of the 275 kV supergrid has gone steadily ahead, but probably not more rapidly than the growth of load will make desirable. Notable among the arrangements made for five years ahead was the preparation of designs for the earliest in the series of nuclear power stations.

On the commercial side 1954–55 was a very successful year; only one Board (South Wales) incurred a deficit, but this was met out of the Board's accumulated revenue balance. The system earned a net surplus of £8·29 million—not an excessive amount on a total revenue of over £365 million; it compares with £5·53 million for 1953–54. This time the figure is arrived at after transferring £10·5 million to a new supplementary reserve for depreciation of fixed assets. This has been set up as a measure for meeting capital expenditure out of revenue and it is stated that it will be necessary in future to earn even larger surpluses for this purpose.

All the Boards report satisfactory expansion; as a whole their sales of electricity increased by 11·2 per cent. Even greater was the growth of their installation and appliance business. Their turnover in this department was about £46·5 million (against £31·7 million); the Eastern Board was outstanding with a figure of £7 million (against £5·3 million in 1953–54). The net surplus of all the Boards as a proportion of total sales rose from 1·8 to 5·6 per cent; it varied from 2 per cent in the case of the South Western Board to as much as 11·6 per cent for the North Eastern Board.

Another notable feature of the Report is the progress made in extending supplies to rural areas. During the year 14,796 more farms were connected; electricity sales to farms showed a 22·4 per cent increase although the number of rural consumers went up by only 9·7 per cent.

SYSTEM INTERCONNECTION

Control of frequency when two large electrical transmission systems are run in parallel, the discussion on which at last week's UNIPEDE Congress is reported in this issue, is particularly relevant to the proposal for a submarine connection with the French high-voltage network. It was only just before the war that the regional sections of the British Grid were linked for normal operation as a whole with consequent great advantage, but the need for an insulated cable across the Straits of Dover introduces a new problem, due to the limits imposed by the heating of its conductors when two methods of frequency control are employed with differing sensitivities. Telephone-line connections between the two systems indicate that under present load conditions the British manual control could normally hold its own with the French automatic control, but it seems doubtful whether it would be adequate in the event of exceptional kVA swings between the two networks.

ORIENTATION OF TRADE

Since the war electrical exports from this country to the European Continent have been on a larger scale than in 1938. The improvement has been caused largely by the temporary eclipse of Germany but now with that country's rapid revival we shall find it more difficult to maintain our Continental business. In the face of this manufacturers (not necessarily electrical) are exhorted in the current "Bulletin for Industry" (published by H.M. Treasury) to concentrate more upon selling to Western Europe and North America. Opportunities in the Continental countries as they recover from the effects of war are considered to be growing. The opinion is expressed that too much effort has been put into selling in the primary producing countries and not enough into persuading manufacturing countries to buy British goods. Although a warning is issued that conditions in the primary producing countries are becoming harder, it seems strange that the Treasury should suggest any weakening of the trade ties between this country and the Commonwealth. Our aim should be to increase our share in all world markets for the goods which we can produce as well and as cheaply as our competitors. We cannot afford to relax anywhere.

WAGES AND EXPORTS

After reviewing his company's activities during the past year and its future activities Sir Harry Railing, chairman of the General Electric Co., Ltd., had something to say at the annual general meeting last week about the economic situation. Generally, Sir Harry reiterated some well-known facts but they were facts which have to be drummed in. He made special reference to the effect of increased wages, unaccompanied by commensurate increases in output, upon our export trade. He estimated that the granting of the latest wage claim in the engineering industry would probably raise the cost of products by from 8 to 10 per cent. The most serious aspect, however, was that continued rises in wages made it impossible for British manufacturers to quote firm prices for long-term contracts. The damage was particularly great in the case of the electrical industry whose products embodied a high labour-cost element. Sir Harry stressed the futility of sectional wage demands which were of short-lived benefit because they engendered inflation.

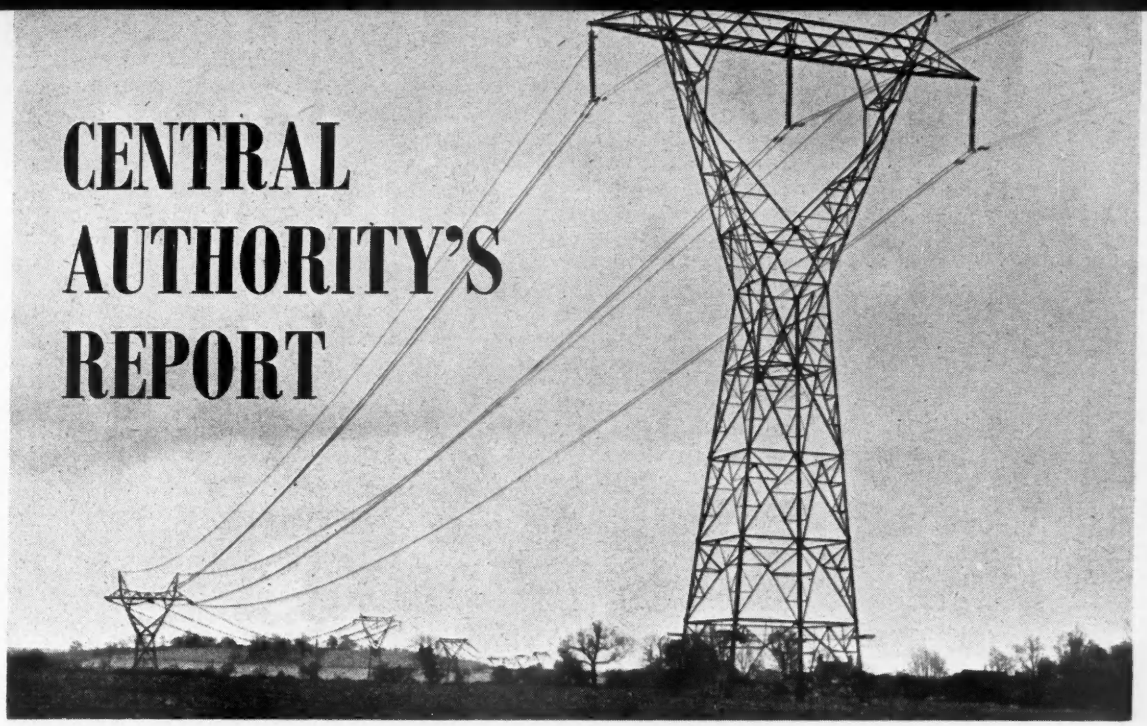
STEEL PRODUCTION

Very many *Electrical Review* readers are no doubt aware of the very considerable effort we have made during the past two years to obtain the comments of the electricity supply industry, the electric furnace manufacturers and the steel manufacturing industry on the report of the Battelle Institute of America on investigations into the use of electric arc furnaces in the United States for the production of ordinary grades of mild steel. Almost immediately after the publication of the report we were able to publish signed contributions by representatives of the electricity supply industry and the electric furnace manufacturers, but we found it difficult to obtain a promise from a steel producer to undertake the task, although we were able to assure ourselves that the many men and authorities we approached were well aware of the very special significance of the report. We now hope to publish an article from the steel-makers' point of view in the fairly near future, but the fact remains that as a body the steel manufacturing industry has been reluctant to express its views. Twice within the past fortnight we have been told by responsible steel manufacturing concerns, that they cannot use arc furnaces for ordinary steel production because the electricity supply tariffs are unfavourable. We will not accept or reject this assertion but we do suggest that it calls for an answer of some sort from the electricity supply industry, because the electrical potentials involved are so enormous.

LOAD FACTOR AND FUEL CONSERVATION

Load factor improvement is so fundamental a consideration to the progress of the electricity supply industry that there is no need to look round for a reason to use it as a topic of discussion at any time, no matter how often. And at the moment when all responsible electrical engineers and managers are thinking in terms of fuel, particularly coal, conservation, it is certainly worth while reflecting on what a comparatively small improvement in the national load factor of electricity supply must mean in terms of the saving of coal. In this connection we do not see why we should resist a temptation to broaden the outlook and think in terms of a national "fuel saving factor." We can well imagine that, under the firm control of the electrical economists, an improvement in this might even justify a fall (which we do not regard as likely) in the electricity supply load factor on the score of greater efficiency of combustion in the boiler furnace than in the domestic solid-fuel fire. After all, improved efficiency of combustion in the power station coupled with improved efficiency of automatically controlled electric space heating in the factory, office and the home is not a new idea and not an untried or unproved idea, but it is obviously one that requires much courage if it is to be pressed home against all the conflicting vested interests.

CENTRAL AUTHORITY'S REPORT



Section of double-circuit 275 kV line running from Staythorpe (Newark) to West Melton (Sheffield)

Electricity Supply Position in 1954-55

THE Report and Statement of Accounts of the British Electricity Authority, which was published on Tuesday (H.M. Stationery Office, 10s), relates to the work of the Authority during the twelve months ended on 31st March of this year. On the following day, with the establishment of the South of Scotland Electricity Board as a separate entity, the Authority assumed its present title—Central Electricity Authority.

During the period covered 73,956 million kWh was generated at the 294 stations of the Authority, an increase of 11·9 per cent over 1953-54. The average thermal efficiency, based on kWh sent out, advanced to 23·85 per cent from 23·40 per cent with a consequent saving of 800,000 tons of coal valued at £2·5 million.

Further particulars of the position compared with that for the previous year are given in Tables 1 and 2. Steam power stations produced 99·13 per cent of the total kWh. The remainder came from other sources in the following percentages: water power, 0·75; waste heat, 0·07; internal combustion engines, 0·05.

Steam stations returning the highest overall thermal efficiencies were: Portobello, Edinburgh (high-pressure section) 31·42 per cent compared with 30·93 per cent, which gave it first place for 1953-54 also; Stourport "B," Worcester, 30·83 per cent; and Littlebrook "B," Dartford, 30·49 per cent. The twenty most efficient stations, which were responsible for more than one-quarter of the 69,497 million kWh sent out, had an average thermal efficiency of 28·74 per cent (28·45 in 1953-54), after deducting from kWh generated 6 per cent used in the stations.

Fuel consumed amounted to 41·07 million tons, made up of: coal, 39·71 million; coke, 1·12 million; oil and other fuels, 0·24 million. Imported coal represented 15·3 per cent of coal deliveries. About 21·8 million tons was transported by rail and 10·7 million (52 per cent from abroad) by the Authority's fleet of 48 sea-going colliers and by vessels on charter. The average price of coal delivered into bunkers, 65s 2d per ton, rose by 3·3 per cent. Fuel accounted for 81·8 per cent of the works costs, but

TABLE 1. GENERATION STATISTICS: ALL B.E.A. STATIONS

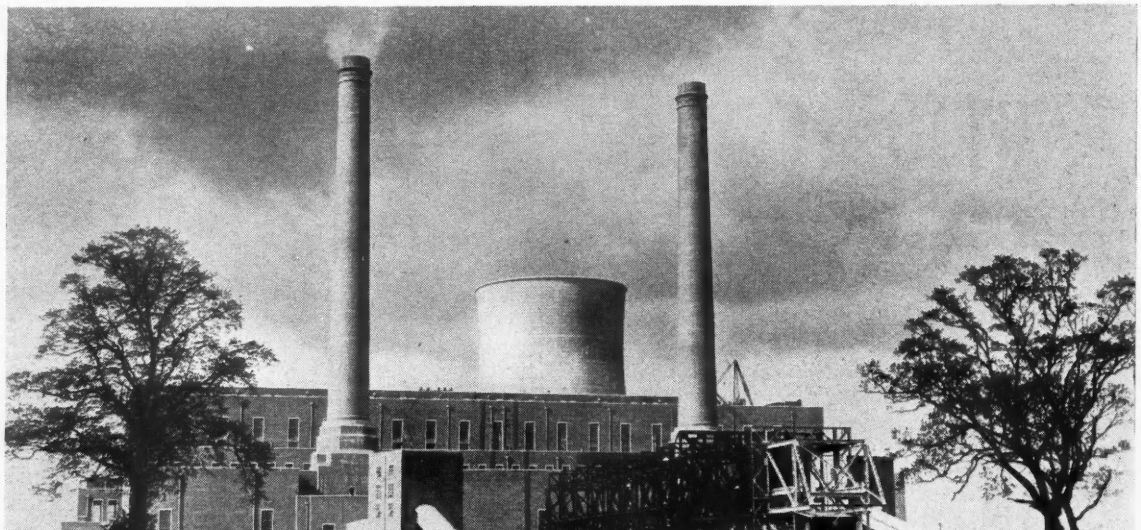
Position at 31st March	1954	1955
Power stations in operation, number	288	294
Installed capacity, MW	18,647	20,173
Maximum output capacity, MW (*a*)	16,904	18,438
Power stations planned or under construction:		
New power stations, number	35	38(*b*)
Existing station extensions, number	57	40
During the years	**1953-54**	**1954-55**
Electricity generated, million kWh	66,107	73,956
Electricity sent out, million kWh	62,121	69,497
New power stations commissioned, number	8	6(*c*)
Existing stations extended, number	23	39
Capacity of new plant, MW	1,419	1,539
Plant shut down, MW	32	30
Maximum demand met, MW	15,430	16,611
Estimated potential demand, MW	16,309	17,200
Plant deficiency, MW	879	950

(*a*) Installed capacity less than required for station auxiliaries and on account of technical limitations (e.g., restricted feeder capacity).
(*b*) Including 7 new sections of stations.
(*c*) Including 1 new section of station.

TABLE 2. STEAM POWER STATIONS: TECHNICAL DETAILS AND COSTS

	1953-54	1954-55
Technical Details		
Steam power stations, number	212	212
Effective output capacity, MW	16,674	18,185
Electricity generated, million kWh	65,587	73,312
Electricity sent out, million kWh	61,608	68,861
Coal burned, million tons	36·15	39·57
Coal pulverized, per cent	41·86	46·78
Coal, calorific value, B.Th.U./lb.	10,783	10,755
Fuel, lb. per kWh sent out	1·352	1·329
Coal cost (excluding handling), d/ton	758·0	782·5
Fuel handling, d/ton	41·0	41·4
Heat rate, B.Th.U. per kWh sent out	14,580	14,309
Thermal efficiency, sent out, per cent	23·40	23·85
Works Costs		
Fuel, including transport, d/kWh	0·4553	0·4623
Fuel handling, etc., d/kWh*	0·0247	0·0245
Operation salaries and wages, d/kWh	0·0358	0·0357
Oil, water and stores, d/kWh	0·0037	0·0037
Repairs and maintenance, d/kWh	0·0399	0·0392
Total, d/kWh	0·5594	0·5654
Employees		
Technical and supervisory	4,593	4,767
Operation (workmen)	17,383	17,811
Repairs and maintenance (workmen)	13,301	13,402
Total per MW output	2·20	2·07

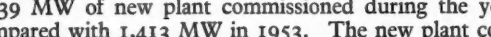
* Includes also pulverizing, ash handling and disposal, and flue gas treatment.



Drakelow power station was brought into service last year when the first of the four 60 MW sets was commissioned

these were higher by only 1·1 per cent than in the previous year. Cost of repairs and maintenance fell by 1·8 per cent and salaries and wages by 0·3 per cent.

At 31st December, 1954, the output capacity of generating plant reached 18,438 MW, including 1,539 MW of new plant commissioned during the year, compared with 1,413 MW in 1953. The new plant comprised 29 turbo-alternators (1,405 MW), 50 boilers (16,220 k lb/hr) and 17 diesel sets (25·78 MW) in 45 power stations. Five of these were new and, not having been in operation for the full twelve months, are excluded from the above comparison of thermal efficiencies. There was also one new section of an existing station.



Growth of public electricity supply in Great Britain, excluding North of Scotland. A.—kWh generated. B.—kWh used in power stations and in transmission and distribution. C.—Total kWh sold to consumers. D.—To industry. E.—To commercial premises. F.—Domestic and farm purposes. G.—Sales for traction. H.—Public lighting

These stations with their initial MW ratings are: Acton Lane "B" (London), 30; Drakelow "A" (Burton-on-Trent), 20; Hackney "B" (London), 30; Ince (nr. Ellesmere Port), 120; Stella South (nr. Newcastle-on-Tyne), 60; Stourport "B," new section, 60.

Obsolete plant with an output capacity of 30 MW was shut down, but of the total plant in operation 19·6 per cent of installed steam-driven generator capacity and 16·5 per cent of boiler capacity (mostly in small units) were 25 years old and upwards.

An average loss of capacity of 11·3 per cent of the total MW installed was experienced during December and January, the usual peak-load months, compared with 12·4 per cent in 1953-54, the causes being breakdown 6·2, overhaul 2·7 and miscellaneous 2·4 per cent.

Load disconnection was necessary on only one occasion as was the case in the previous year and load spreading was not called for. The maximum demand met was 16,611 MW. A potential demand of 17,200 MW occurred on Thursday, 20th January, and had to be reduced by 950 MW by lowering frequency and voltage. System load factor, based on maximum potential demand, was 46·5 per cent.

Plant Construction

A plant programme of 2,180 MW for 1960 was approved during the year; this provided for fourteen 60 MW generating sets, one 100 MW set, seven of 120 MW and two of 200 MW. During the six years from 1955 to 1960 generating capacity will be increased by over 45 per cent to provide 26,650 MW at the end of 1960.

The 210 MVA generator transformers will be single three-phase units, which has been found practicable by the use of cold-reduced grain oriented steel and are within road transport limits of weight.

Parliamentary sanction is being sought to construct a 300 MW pumped storage plant in Merionethshire and

TABLE 3. MAIN TRANSMISSION SYSTEM

In Commission at 31st March	1954	1955
Overhead lines, route miles:		
Operating at 275 kV	41	41
" " 132 kV	4,537	4,951
" " 66 kV and below	133	133
Underground cables, route miles:		
275 kV	—	—
132 kV	78	87
66 kV and below	366	370
Grid substations, number	323	350
Transformer capacity, MVA:		
275 kV	240	240
132 kV	18,848	20,992
66 kV and below	2,113	2,203

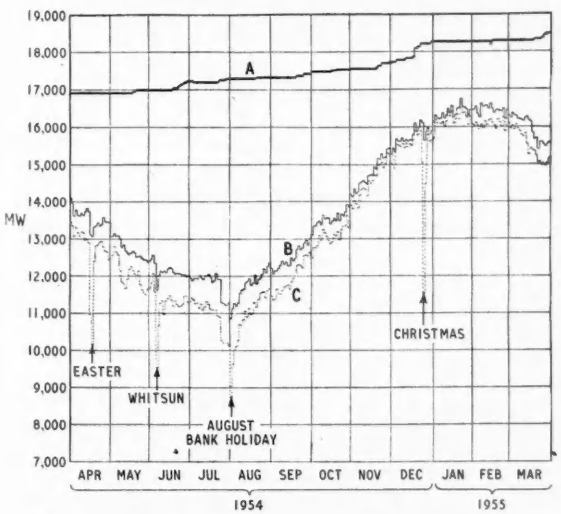
for a 49 MW normal hydro-electric scheme partly in Cardiganshire and partly in Merionethshire. The Department of Scientific and Industrial Research has been asked to continue its model test of the Severn estuary with a view to a possible later tidal power scheme.

A new thermodynamic cycle, for which a high thermal efficiency is claimed, has been investigated. Steam is the working medium and a principal feature is a superheater designed to permit direct heat transfer from the burning fuel to the steam, thus eliminating the water-boiling process.

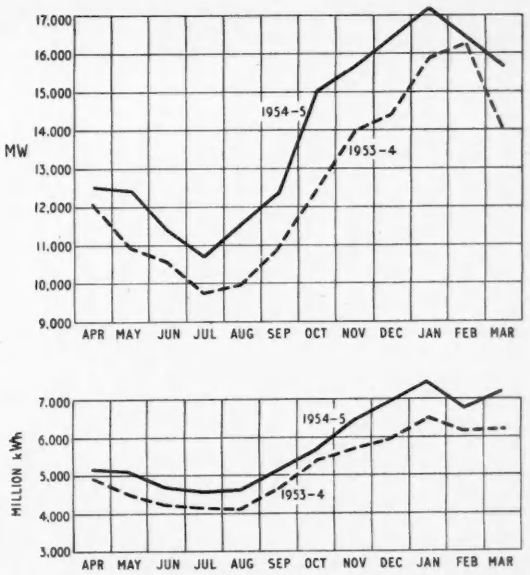
The effect of humidifying pulverized fuel flames was studied at Brighton and Llynfi power stations, using 1 lb of steam per 1,000 lb of combustion air; in both cases the admission of steam across the flame alleviated slagging trouble. Stoker-fired boilers, however, did not benefit, except at Fulham, where retort stokers are installed. An attempt to reduce the fouling of superheaters at Hams Hall " B " station (near Birmingham) had only moderate success; in this case the boilers are fired from the front wall, whereas those at Brighton and Llynfi are fired by downshot burners giving V-shaped flames.

The Authority started the year 1954-55 with 4·2 million tons of coal in stock (five weeks of normal winter consumption), and during the summer the amount was raised to 6·1 million tons. By the end of March this year, the figure had fallen to 3·5 million tons, the lowest since 1951.

Particulars of the main transmission systems are given in Table 3. Major works started for the grid included:

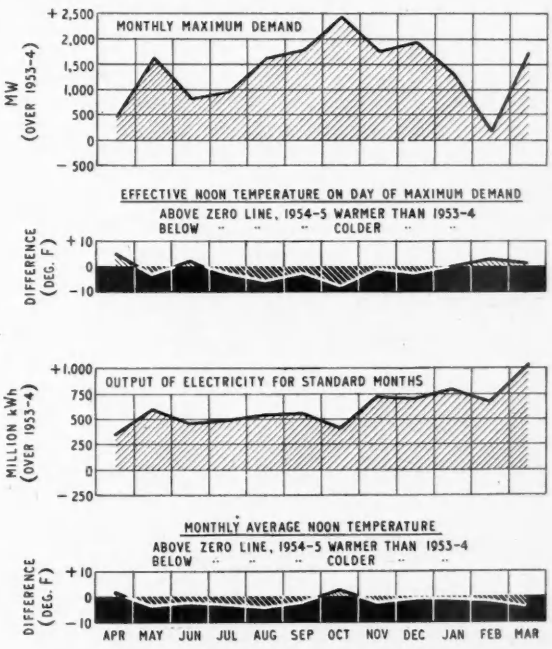


Plant capacity and system demand. A.—Maximum output capacity with all plant in service. B.—Available output capacity after allowing for losses due to breakdown, overhaul and other generating plant limitations. C.—Output capacity as in B less capacity unused because of local circuit limitations within grid control areas. The MW capacity corresponding to 746 million kWh purchased from outside sources is ignored



Monthly maximum potential demand (half-hourly) and (bottom) monthly output of B.E.A. power stations including allowance for low frequency, voltage reduction or disconnection of supply

149 route miles of lines at 275 kV and 303 miles at 132 kV; 1,180 MVA of 275 kV transformers and 2,355 MVA of 132 kV transformers; 32 275 kV and 139 132 kV circuit-breakers. Further sections of the 275 kV supergrid, comprising 165 route miles of double circuit overhead lines were brought into operation at 132 kV, pending completion of substations. New grid supply points to the Area Boards numbered 23, making 120 since vesting day with a saving of £11·6 million on the costs which would have been incurred by developing existing points.


MONTHLY MAXIMUM DEMAND
MW (OVER 1953–4)
EFFECTIVE NOON TEMPERATURE ON DAY OF MAXIMUM DEMAND
ABOVE ZERO LINE, 1954–5 WARMER THAN 1953–4
BELOW " " " COLDER
DIFFERENCE (DEG. F)
OUTPUT OF ELECTRICITY FOR STANDARD MONTHS
MILLION kWh (OVER 1953–4)
MONTHLY AVERAGE NOON TEMPERATURE
ABOVE ZERO LINE, 1954–5 WARMER THAN 1953–4
BELOW " " " COLDER
DIFFERENCE (DEG. F)
APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR

Load and weather differences between 1953–54 and 1954–55. The monthly maximum demand is the average (whether wholly supplied or not) on B.E.A. stations over the half-hour of highest demand in each month

Schemes for connecting 1,900 MW of new generating plant to the grid were approved. Over a quarter of the capacity will be connected direct to the 275 kV system—the first examples of alternator switching at that voltage. About 1,130 MW is to be connected direct to the 132 MV system; 75 per cent of new capacity approved since vesting day will be so switched compared with 4 per cent of the total capacity at vesting day.

Three 120 MVA circuits of 132 kV gas-pressure cables were put in hand to extend for 5¼ miles from Brunswick Wharf power station. Designs of a 275 kV double-circuit crossing of the rivers Severn and Wye, near Chepstow, have been completed. The span over the Severn will be one mile and that over the Wye 1,500 yd; each conductor will be manufactured without joints and will be 1·625in in diameter with a core of 91 steel strands surrounded by 78 aluminium strands. The towers will be nearly 500ft high.

During 1954-55 the grid system sustained 382 faults, 92·1 per cent of which were correctly cleared, compared with 468 in the previous year with 86 per cent correct clearances.

Among the large number of research items was one to discover the temperatures that do not harm fish. It was provisionally established that, for most species, tolerable temperatures are at least as high as those caused by the discharge of circulating water into rivers.

Some 6 million tons of ash is produced from the combustion of coal at power stations of which 2½ million tons is fine dust from pulverized firing, which should make a satisfactory substitute for cement.

By the end of the period under review the number of consumers had risen to 14,911,135, an increase of 3·8 per cent during the year. As will be seen from Table 4 the number of farm consumers (9·7 per cent increase) showed the greatest advance as did their consumption (22·4 per cent increase). As regards traction two more street systems were lost and consumption fell by 11·1 per cent; on the other hand there was an 11·5 per cent increase in electricity used for railway traction, partly on account of the fuller operation of the Manchester-Sheffield line. The increase in domestic sales was considerably greater than in the previous year (10·5 per cent, against 2·9 per cent) and the other classes also made headway; the result was a general rise of 11·8 per cent, against 6·9 per cent in 1953-54.

TABLE 4. CONSUMERS AND SALES

Class	No. of Consumers 31.3.55	Per cent inc. or dec. on 1953-54	Sales of Electricity 1954-55 Million kWh	Per cent inc. or dec. on 1953-54
Industrial	161,485	+1·6	32,063	+12·8
Commercial* ...	1,437,692	+2·0	8,844	+11·0
Domestic* ...	13,140,400	+4·0	18,486	+10·5
Farm	167,375	+9·7	972	+22·4
Traction:				
Rail	67	−2·9	1,070	+11·5
Street			392	−11·1
Public Lighting ...	4,116	+4·1	583	+ 9·2
Totals	14,911,135	+3·8	62,410	+11·8

* Including combined domestic and commercial supplies.

Boards' Sales

Sales to various classes of consumers by the fourteen Electricity Boards are set out in Table 5. Again the North Western Board by reason of its large industrial load headed the list with the Midlands and Yorkshire Boards close behind. As in the preceding year the South Western Board recorded the greatest proportional increase (19·6 per cent) with Merseyside and North Wales next (15·8 per cent).

The total sent out from the B.E.A. power stations in 1954-55 was 69,497 million kWh and 547 million kWh was purchased from outside sources; of this 1,431 million kWh was sold direct to consumers. Sales to the Boards totalled 67,068 million kWh and they also purchased 199 million kWh from outside sources.

Railway traction sales by the B.E.A. amounted to 867 million kWh and by the Boards 203 million kWh. It was agreed between the Authority and the British Transport Commission that for the Shenfield to Chelmsford and Southend electrification 33 kV supplies should be made available at a number of points instead of at one large substation; it is hoped that supply will be provided at the first point by the end of this year. Reference is made in the report to the railways' modernization plan.

The structure of the bulk supply tariff for energy supplied by the B.E.A. to the Boards remained the same but the fuel cost adjustment was reduced from 0·00065d to 0·0006d per penny variation in the cost of fuel in the respective areas. A new feature was introduced to minimize the effects on trading results of substantial differences between actual and estimated demands. The load factors of bulk supply from the Authority to the Boards varied from 40·4 per cent (London) to 59·4 per cent (South Wales).

During the year the Yorkshire Board introduced standard tariffs for industrial consumers. Some Boards have not yet published standard tariffs for all the main classes of consumers but in these few cases the position is under close review so that as soon as practicable tariffs broadly conforming with the recommendations of the Retail Tariffs

TABLE 5. ANALYSIS OF ELECTRICITY BOARDS' SALES

Board	Population at 30.6.54 (Thous.)	No. of consumers (Thous.)	Sales of Electricity (Thousands of kWh)							
			Domestic	Farm	Commercial	Industrial	Public Lighting	Traction	Total (excl. inter-Board sales)	Inc. over 1953-54 Per cent
London	5,076	1,697·9	2,150,341	482	1,640,064	1,499,206	101,119	82,209	5,473,421	8·0
S. Eastern	3,285	1,089·8	1,673,115	61,201	557,796	983,153	37,543	19,265	3,332,073	9·8
Southern	3,860	1,170·1	1,578,174	129,255	710,742	1,500,185	31,096	16,021	4,063,562	12·1
S. Western	2,138	672·9	817,996	66,375	378,236	801,280	19,951	—	2,083,838	19·6
Eastern	4,905	1,541·1	2,289,847	123,890	717,714	2,072,442	45,898	127,123	5,511,877†	10·8
E. Midlands	3,725	1,161·1	1,389,646	126,673	419,307	2,695,359	36,095	20,412	4,787,837†	11·5
Midlands	4,157	1,261·1	1,678,024	105,020	698,273*	3,831,325	38,586	17,750	6,502,320†	11·4
S. Wales	1,993	556·5	515,197	21,827	263,467	2,997,871	22,217	7,833	3,828,412	12·4
Merseyside and N. Wales ...	2,860	812·7	977,541	62,641	555,976	2,069,512	30,672	69,466	3,765,808	15·8
Yorkshire	4,183	1,367·9	1,427,453	54,689	512,504	4,091,664	47,820	113,880	6,395,712†	11·8
N. Eastern	2,996	872·8	792,059	41,075	395,104	2,388,892	26,395	59,380	3,702,905	9·8
N. Western	4,564	1,501·8	1,727,891	90,883	855,746	4,154,450	61,217	41,360	6,931,547	9·1
S.E. Scotland	1,339	409·8	434,843	26,797	216,680	642,363	23,531	19,847	1,364,061	12·7‡
S.W. Scotland	2,580	795·6	902,877	61,612	438,895	1,771,453	61,315	—	3,236,152	10·2‡
Totals	47,661	14,911·1	18,355,004	972,420	8,360,504	31,499,155	583,455	594,540	60,979,525	11·2

* Including small industrial supplies.
† Including combined domestic and commercial (thousand kWh): Southern, 98,089; Eastern, 134,963; E. Midlands, 100,345; Midlands, 133,342; and Yorkshire, 147,702; total, 614,441.
‡ Includes small supplies to North of Scotland Hydro-Electric Board.

TABLE 6. ELECTRICAL CONTRACTING AND SALES OF FITTINGS

Board	Sales		Direct Costs				Indirect Costs		Surplus or Deficit			
	1953-54	1954-55	1953-54	Per cent*	1954-55	Per cent*	1953-54	1954-55	1953-54	Per cent*	1954-55	Per cent*
	£	£	£		£		£	£	£		£	
London	3,047 190	3,803,588	2,526,951	82·9	3,067,764	80·7	470,685	552,557	49,554	1·6	183,267	4·8
S. Eastern	2,375,967	3,265,868	1,869,694	78·7	2,513,765	77·0	425,561	474,876	80,712	3·4	277,227	8·5
Southern	2,814,407	4,042,997	2,238,672	79·5	3,192,623	79·0	530,026	653,426	45,709	1·6	196,948	4·9
S. Western	1,919,017	2,460,554	1,534,071	79·9	1,935,555	78·7	443,245	474,183	−58,299	−3·0	50,816	2·0
Eastern	5,309,185	7,029,542	4,322,047	81·4	5,628,137	80·1	849,287	1,110,480	137,851	2·6	290,925	4·1
East Midlands	1,504,625	2,255,259	1,226,915	81·5	1,817,551	80·6	241,820	307,967	35,890	2·4	129,741	5·7
Midlands	4,254,168	6,374,835	3,391,125	79·7	5,084,961	79·8	837,319	991,350	25,724	0·6	298,524	4·7
S. Wales	1,070,746	1,724,816	893,131	83·4	1,368,021	79·3	236,356	287,768	−58,741	−5·5	69,027	4·0
Merseyside and N. Wales ...	1,391,753	2,143,425	1,138,524	81·8	1,763,299	82·3	205,670	274,336	47,559	3·4	105,790	4·9
Yorkshire	2,672,517	4,317,395	2,211,989	82·8	3,521,038	81·6	378,769	489,405	81,759	3·0	306,952	7·1
N. Eastern...	1,088,137	2,133,786	881,460	81·0	1,730,599	81·1	130,390	156,250	76,287	7·0	246,937	11·6
N. Western	3,151,249	5,043,148	2,593,826	82·3	4,082,564	81·0	478,086	662,324	79,337	2·5	298,260	5·9
S.E. Scotland	572,466	862,416	460,134	80·4	681,645	79·0	90,245	107,297	22,087	3·8	73,474	8·5
S.W. Scotland	569,653	1,036,033	477,709	83·9	858,729	82·9	73,377	94,742	18,567	3·2	82,562	8·0
Totals	31,741,080	46,493,662	25,766,248	81·2	37,246,251	80·1	5,390,836	6,636,961	583,996	1·8	2,610,450	5·6

*On total sales.

Committee will be generally available. Operation of the new standard tariffs is carefully watched for the purpose of introducing improvements.

A record number of farms (14,796) was connected during the year. At the end of the period 167,375 farms were connected (60 per cent of the total) and about 75 per cent of other rural premises were connected. Since vesting day (1948) the number of farm connections has risen by 85 per cent. Special attention is being given to promoting the economic use of electricity on the smaller farms which represent a high proportion of the substantial increase in farm connections.

Work on the standardization of electrical appliances and accessories continued through the channels provided by the British Standards Institution and the British Development Association and a number of new or revised specifications were prepared. The Authority and the Boards play an active part in the development of new and improved electrical appliances, e.g., the dual purpose domestic heat pump. Increasing general interest was displayed in the off-peak heating of industrial and commercial buildings. Improvements in the design of plant and equipment and in methods of operation are normal features of the work of the electricity supply industry.

Reference is made in the report to the setting up of the National Inspection Council for electrical installation contracting. The results of the Boards' contracting and sales of "fittings" activities are shown in Table 6. The sales of appliances reached a record level; there was a marked increase in the numbers of cookers and water heaters installed although hire-purchase restrictions had an effect upon the rate of increase in sales in some parts of the country.

Further steps were taken to stimulate the commercial use of pulverized-fuel ash and a marketing officer was appointed to co-ordinate the various activities. Over 200,000 tons of ash is sold yearly but this is small in relation to the available quantities. The Authority has approved in principle the erection of a plant at Battersea power station to produce a light-weight aggregate for which, it is believed, there will be a substantial demand from the building industry. The plant will be owned

Interior of Littlebrook "B" power station showing the boiler plant and turbo-alternators under the same roof

by a building contracting company who will buy the ash from the Authority and market an estimated 65,000 tons of aggregate a year. Negotiations are proceeding for the erection of such plants at other power stations.

Comparative trials of electric and gas water heaters have been concluded. They showed the weekly expenditure on electricity and gas to be about the same with electricity at 1d/kWh and gas at 1s 6d/therm. Load analysis tests have been completed and a survey to determine the number and distribution of appliances was made early this year. Other forms of utilization research are mentioned.

At the end of March last the number of persons employed by the Authority was 51,871 and by the Area Boards 138,151, a total of 190,022 of whom 11·5 per cent were women; the total showed an increase of 2·9 per cent during the year. An analysis shows the following proportions of the various grades:—Managerial and higher executive 0·8 per cent; technical engineering 8·4 per cent; executive, clerical, accountancy, sales, etc., 22·1 per cent; manual 64·8 per cent; and technical trainees and apprentices 3·9 per cent.

Particulars are given of the negotiations relating to terms and conditions of employment during the year; of joint consultation proceedings; safety, health and welfare; and education and training.

Under the heading "Some Administrative and Other Matters" the report deals with the Electricity Reorganization (Scotland) Act, 1954, which separated the Scottish undertakings from the B.E.A.'s system and established the South of Scotland Electricity Board; the Herbert Committee of Inquiry into the electricity supply industry; civil defence; superannuation; statutory consents to power plant; wayleaves; joint meter reading, etc.

Financial Results

The combined revenues of the Authority and Boards amounted to £365·68 million of which electricity sales represented £356·33 million, against £326·55 million in 1953-54 (electricity sales £319·57 million). Combined expenditures totalled £346·89 million, against £313·36 million, leaving a surplus of £18.79 million (£13·19 million). Of this £10·5 million is transferred to supplementary reserves for depreciation of fixed assets, leaving a net surplus available for general reserves of £8·29 million, against £5·53 million in 1953-54.

The establishment of supplementary reserves referred to above is in accord with the previously-declared policy of the Authority and Boards not only to provide for depreciation on a "historic cost" basis but also to create reserve funds to meet occasional deficiencies and assist in financing the replacement of assets. In general the Area Boards continued to apply their surpluses largely in making contributions to area reserve funds available for financing the replacement of fixed assets. But the London Board decided to establish a supplementary depreciation reserve with an initial contribution of £500,000, while continuing to build up the area reserve fund.

TABLE 8. AVERAGE PRICE PER KWH SOLD

Class	1953-54	1954-55
	d	d
Industrial	1·143	1·149
Commercial	1·911	1·901
Domestic	1·532	1·518
Combined domestic and commercial	1·670	1·728
Farm	1·463	1·472
Traction	1·089	1·108
Public lighting	1·393	1·392
Totals	1·373	1·370

The provision of capital to meet the heavy cost of the industry's development and expansion remains a dominant feature of the Authority's finances. In 1954-55 the requirements amounted to £203 million which was largely provided by borrowing. Annual capital requirements will continue to be of this order and the provision of nuclear power stations is likely to increase them. It is clear that it is necessary to earn larger surpluses to provide for a greater degree of self-financing of future capital programmes.

The Central Authority's accounts show total costs of £224·83 million, including generation costs of £213·51 million, equivalent to 0·7373d/kWh against 0·7295d/kWh in 1953-54. Trading revenue amounted to £246·78 million (0·8456d/kWh, against 0·8321d/kWh). After meeting administration and other expenses the surplus was £11·58 million (£8·01 million).

Table 7 shows that the aggregate revenue of the fourteen Area Boards was £360·4 million and total expenditure £353·2 million, leaving a surplus of £7·2 million. From this £82,000 is transferred to the central reserve fund and £4,600,000 to Area reserve funds. The revenue per kWh sold (excluding inter-Board sales) was 1·380d, against 1·381d in 1953-54. The South Wales figure was again the lowest (1·066d against 1·064d) and the London figure the highest (1·781d against 1·812d). The average revenue per kWh from the various classes of supply is shown in Table 8.

It will be seen from Table 6 that there was a considerable expansion in the Boards' electrical contracting work and appliance sales; the total revenue from this source, £46·5 million, represented an increase of nearly 47 per cent. The net surplus rose from £583,996 to £2,610,450, or from 1·8 to 5·6 per cent on total sales.

The consolidated balance sheet shows net fixed assets of £1,095·35 million; interests in subsidiary companies

TABLE 7. AREA BOARDS' REVENUE AND EXPENDITURE

Board	Total Income		Total Expenditure		Surplus or Deficit		Revenue per kWh sold (pence)*	
	1953-54	1954-55	1953-54	1954-55	1953-54	1954-55	1953-54	1954-55
	£	£	£	£	£	£		
London	39,627,361	42,029,550	40,843,698	41,172,271	1,160,009	857,279	1·814	1·781
South Eastern	21,175,741	23,457,245	21,281,616	22,748,190	−105,875	709,055	1·573	1·576
Southern	24,834,987	27,903,770	24,231,193	27,030,838	603,794	872,932	1·593	1·590
South Western	12,420,816	14,638,318	12,322,560	14,201,274	98,256	437,044	1·677	1·642
Eastern	32,340,328	35,923,494	32,535,589	35,865,528	−195,261	57,966	1·521	1·519
East Midlands	23,574,913	26,710,548	23,333,938	26,184,615	240,975	525,933	1·283	1·299
Midlands	31,486,960	36,330,282	31,105,709	34,896,322	381,251	1,433,960	1·269	1·305
South Wales	15,267,767	17,304,580	15,074,519	17,483,772	193,248	−179,192	1·064	1·066
Merseyside and N. Wales	18,475,221	20,979,577	17,935,932	20,354,734	539,289	624,843	1·336	1·306
Yorkshire	27,836,032	31,023,286	27,566,889	30,829,115	269,143	194,171	1·137	1·127
North Eastern	18,294,567	20,356,399	17,875,421	19,863,619	419,146	492,780	1·272	1·279
North Western	35,025,248	38,630,222	34,003,725	37,727,790	1,021,523	902,432	1·296	1·303
S.E. Scotland	6,972,716	7,946,241	6,736,689	7,813,034	236,027	133,207	1·368	1·373
S.W. Scotland	16,358,910	18,293,340	16,043,424	18,137,326	315,486	156,014	1·331	1·344
Totals (excluding inter-Board bulk supplies)	322,613,089	360,436,357	317,436,078	353,217,933	5,177,011	7,218,424	1·381	1·380

* Excluding inter-Board sales.

£0·96 million; investments £46,099·07 million (less £2·86 million realized profits); and current assets of £149·87 million. On the other side, capital liabilities are given as £1,064·72 million; capital reserves £10·50 million; revenue reserves £49·81 million; and current liabilities £200·37 million (including £113·11 million temporary bank loans).

The reports of the individual Electricity Boards will be reviewed in subsequent issues.

Minister's Report

The report of the Minister of Fuel and Power, published at the same time as the B.E.A. and Electricity Boards' reports, refers to the increase (in July last year) of the borrowing powers of the B.E.A. and Boards from £700 million to £1,400 million and to the changes effected by the Electricity Reorganization (Scotland) Act, 1954. Details are given of appointments and reappointments to the B.E.A. and Boards.

It is stated that the Central Authority estimates generating plant requirements at 25,465 MW (sent out) by the beginning of 1960. The annual commissioning rates approved by the Minister are on a rising scale from 1,550 MW in 1955 to 1,950 MW in 1959 and 1960. "He has, however, kept under review the financial implications of the programme in relation to the Government's annual review of capital investment."

The coal situation is mentioned (by 1960 the Central Authority's requirements will be 50 million tons a year) and reference is made to the contracts for oil fuel which the Authority has signed. The erection of twelve nuclear power stations in the next ten years is also referred to.

Other matters dealt with in the report are research, training, the Herbert Committee, Consultative Councils, and consents to the North Wales Hydro-Electric Power Bill (now an Act) and the Bill now before Parliament empowering the Authority to discharge ash into the sea from the projected Blyth power station, Northumberland.

Consent was given to the issue of £100 million British Electricity Stock in August, 1954, and sanctions to temporary borrowing are set out in the report.

The erection of the Elland (Yorks), Belvedere (Kent), Rogerstone (Mon), Machynlleth "B" (Montgomeryshire), Blyth and Kincardine stations was sanctioned—a total of 1,984 MW of plant. Consents were issued to the extension of the Bold, Drakelow and Skelton Grange stations—a total of 1,020 MW.

The rest of the report relates to various other consents —overhead lines, wayleaves, etc.

Fuel Costs

Lord Citrine, chairman of the Central Electricity Authority, discussed the Report at a Press conference on Tuesday. He said that the severe increase in the price of coal last July was estimated to cost the Authority £20 million in a full year. This was bound to have a considerable effect on the surplus for the current year. Although about half of the increase would be recovered by Area Boards from industrial consumers under the fuel price adjustment clause, the increases in charges to domestic, commercial and other consumers would not begin to take effect until October. Thus the Electricity Boards would find it impossible to provide an increased amount from internal resources for financing the capital programme.

The Boards were feeling the effect of the "credit squeeze" and efforts were being made to curtail capital costs of distribution by about 10 per cent. Rural electrification could thus not progress at the rapid pace hoped for, but the Boards still hoped that the number of farms connected would not fall materially below the average of 12,000 per year. Lord Citrine pointed out that the average price per kWh last year was only 30 per cent above pre-war, although coal costs, which accounted for 80 per cent of generating costs, were up by 270 per cent.

charges from 6 per cent to a minimum of 7 per cent, charges from 6 per cent to the minimum of 7 per cent, which it was expected would have a considerable effect on the amount of hire-purchase sales. Since the re-imposition of restrictions in February there had been a diminution in these sales.

Atomic Power Station Sites

Referring to the atomic power programme, Lord Citrine said that broad considerations pointed to the South of England and in particular to the Severn Estuary and the coast of Essex as the most suitable areas for the first atomic power stations. Various sites had been investigated and he thought that decisions would be made in the next few weeks. Important as nuclear power might be it must not be imagined that unlimited supplies from that source were just around the corner. Present plans, which might be accelerated, envisaged a capacity of about 2 million kW being provided by nuclear power by 1965. The total amount of generating plant by that time would be about 35 to 40 million kW. In view of this and the indications of continuing coal shortage the C.E.A. had come to agreements for the supply of oil. By 1965 some 16 stations would be using oil fuel at a rate equivalent to about 10 million tons of coal a year.

Australian Electrical News

From a Correspondent

Of particular interest to the electrical appliance trade is a recent survey conducted by the Australian Association of National Advertisers. This shows that of the 1,074,000 homes in Sydney, Melbourne and Brisbane, 118,000 have no source of hot water in their bathrooms, and 10 per cent of these homes are occupied by families of the middle income group. Only 26 per cent of all families in the three cities have running hot water in kitchen, bathroom and laundry. Approximately 107,000 families have neither vacuum cleaner, electric washing machine, refrigerator nor electric floor polisher. Electric sewing machines were found in 29 per cent of homes, and electric razors in 24 per cent.

The recent Victorian State Electricity Commission £2 million loan has closed undersubscribed by £570,000, but the chairman, Mr. R. A. Hunt, says that the result should be regarded as satisfactory "in view of the number of issues in the market during the short period allowed for the flotation."

"How long will import restrictions be necessary?" asks Professor H. W. Arndt of Canberra University College. He answers his own question by saying that they will be an inevitable feature of the Australian economy until more fundamental corrective measures are taken. He urges that a policy of import replacement be adopted through the development of secondary industries as the best solution to "the chronic problem" of import restrictions. "Those industries should be protected which stand the best chance of competing with imports," he says. "What we must avoid is not protection as such, but protection for relatively inefficient industries."

The Australian Trade Commissioner in Malaya reports that there is a valuable market in that country for both large and small transformers, overhead line equipment, constructional steelwork for electrical projects, poles, brackets and ladders. He points out that the Central Electricity Board, Kuala Lumpur, has complete freedom to purchase from any source. It is purchasing at the moment at the rate of a little over $20 million annually, and this figure will be increased as large-scale developments get under way. The Perak River Hydro-Electric Co., Ipoh, is also buying through London agents, Balfour, Beatty & Co.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Mr. E. R. Wilkinson, M.I.Mech.E., M.I.E.E., commercial manager, Central Electricity Authority, is relinquishing his post at the end of the year to join the boards of Power Securities Corporation, Ltd., and of Balfour Beatty & Co., Ltd. Mr. Wilkinson received his technical education and engineering training at the Preston Technical College and at the Dick Kerr Works of the English Electric Co., Ltd., and was later engaged on power station design and operation. In 1924 he joined Merz & McLellan, consulting engineers, and four years later was appointed deputy commercial manager to the Central Electricity Board. In 1937 he became commercial manager and when the Electricity Act, 1947, was passed he was appointed in a similar capacity by the Central Authority. Mr. Wilkinson was president of the Association of Supervising Electrical Engineers, 1944-1946, chairman of the British Electrical Development Association, 1950-51, and in an advisory capacity has carried out a number of missions abroad, including the Four-Power Conference, Paris, 1946, the Uganda Electricity Board, 1953, and the International Bank for Reconstruction and Development, Mexico, 1954-55.

Mr. E. R. Wilkinson

Mr. H. W. Bosworth, at present chairman of Lancashire Dynamo Holdings, Ltd., will give up this position at the end of the year. The chairmanship will then be taken by **Sir Percy H. Mills,** Bt., K.B.E. Mr. Bosworth will retain his seat on the board of the company and his connection with the associated companies.

Lancashire Dynamo Holdings has appointed **Mr. S. F. Steward,** C.B.E., M.I.Prod.E., as managing director of the company and the Minister of Fuel and Power has agreed to release Mr. Steward from his present position of chairman of the South Western Electricity Board at the end of the year; his appointment with Lancashire Dynamo Holdings will take effect from that date.

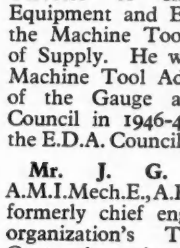
Mr. H. W. Bosworth

Mr. S. F. Steward

Mr. Steward has been chairman of the South Western Electricity Board since its inception in 1948 when he relinquished his directorship of Bull Motors (E. R. & F. Turner, Ltd.). During the last war he served as Director-General of Machine Tools, Director of Industrial Electrical Equipment and Electrical Adviser to the Machine Tool Control, Ministry of Supply. He was chairman of the Machine Tool Advisory Council and of the Gauge and Tool Advisory Council in 1946-47 and chairman of the E.D.A. Council, 1954-55.

Mr. J. G. Dawson, B.Sc., A.M.I.Mech.E., A.F.R.Ae.S., M.Inst.F., formerly chief engineer of the Shell organization's Thornton Research Centre, has taken up a new appointment as manager of the Experimental Department of F. Perkins, Ltd., Peterborough.

Mr. W. T. Gann, M.B.E., M.I.E.E., manager of the Southport District of the Merseyside and North Wales Electricity Board, retires this week. Before going to Southport forty years ago, he was an assistant in the Rochdale undertaking. He served as deputy electrical engineer to the late Mr. E. Moxon at Southport, and on Mr. Moxon's retirement became borough electrical engineer, a position he occupied until vesting day. Since then he has been in the service of the Board.



Mr. W. T. Gann

Mr. F. D. Gunton, B.Sc.(Eng.), A.M.I.E.E., and **Mr. O. S. Steele,** B.Eng.(Elec.), who write on "Electric Arc Furnaces" in this issue (p. 639), are both with the British Thomson-Houston Co., Ltd. Mr. Gunton obtained his London external degree with first-class honours in 1943 and for the next four years lectured in mechanical engineering at the Borough Polytechnic, London, in connection with various intensive and Service courses. He joined the B.T.H. Co. as a graduate apprentice in 1947 and in 1949 entered the development section of the Industrial Engineering Department, taking part in work on arc furnace control and having responsibility for this work from 1950 to 1952, the first amplidyne-type arc furnace electrode regulator being put to work in January, 1950. He was concerned with various applications of electric drive and control until appointed assistant manager, Education Department, in January, 1955.

Mr. Steele obtained his degree at Nova Scotia Technical College in 1944 after which he was an electrical officer in the minesweeping service, R.N.V.R., from 1944 to 1946. After demobilization he joined the International General Electric Co., Ltd., and Canadian General Electric Co., Ltd., as assistant to the manager, Newfoundland office, until 1950. From that time he has been with the B.T.H. Industrial Engineering Department as electric drive application engineer on arc furnaces and process lines.

Mr. F. D. Gunton

Mr. O. S. Steele

The North of Scotland Hydro-Electric Board has appointed **Mr. Angus A. Fulton,** F.R.S.E., B.Sc., M.Inst.C.E., M.I.Mech.E., as general manager in succession to the late Mr. Thomas Lawrie. Mr. Fulton has been the Board's chief hydraulic and civil engineer since 1944. He was born at Motherwell in 1900 and was educated at Dundee High School, University College and St. Andrews University. After graduating he spent three years on the staff of Dundee Corporation Water Department before joining Boving and Co., Ltd., on behalf of which company he carried out hydro-electric work in New Zealand, India, and South America. He returned to Dundee Corporation as chief assistant engineer in the Water Department and in 1938 was appointed engineer and manager, a position he held until he joined the Board.

The Brush Group, Ltd., announces that **Mr. J. P. Ford** is relinquishing his post as managing director of its export companies (Associated British Oil Engines, Ltd., Brush Exports, Ltd., and National Oil Engines, Ltd.) with effect from 1st November in order to

join the board of Charles Colston, Ltd. **Mr. M. C. Clear** will assume the office of managing director of the three export companies from the above date in addition to his present office of sales director of the Brush Group. **Mr. G. N. Bridge** is appointed London manager of the same companies with effect from 1st November.

Mr. Orlando Oldham and **Mr. P. J. Brocklehurst** have been appointed to the board of Oldham & Son, Ltd.

Mr. O. Oldham

Mr. Oldham, who is twenty-eight, was educated at Uppingham School and Jesus College, Cambridge. Following three years' service with the Fleet Air Arm and twelve months in the Oldham works, he attended the Harvard Business School, Harvard University, in America, for two years where he graduated as a Master of Business Administration. Returning to England in 1952 he continued his training with three years' practical experience in the Oldham works at Denton, Manchester. In 1954 he was appointed the company's liaison officer with Dewey & Almy, Ltd., of Boston, Mass, U.S.A., and in 1955 he was made assistant to the general manager.

Mr. Brocklehurst was educated at Uppingham and the Royal Military College, Sandhurst. In 1939 he entered the family firm of C. Brocklehurst & Son, becoming a junior partner in the firm in 1949.

Following the retirement of Mr. L. H. A. Carr at the end of April, the Metropolitan-Vickers Electrical Co., Ltd., appointed **Mr. A. Walsh,** Assoc.M.C.T., M.I.E.E., as consulting engineer (patents). Mr. Walsh was educated at Bolton Technical School and Manchester College of Technology. He joined the former British Westinghouse Co. in 1917 as a school apprentice, spending the last two years of his course as a junior engineer on motor design. Subsequently he joined the staff of the Motor Engineering Department, and in 1929 became engineer-in-charge of the a.c. design section. He was appointed assistant chief engineer, Motor Department, in 1949. Before the war Mr. Walsh was closely concerned with the electrical equipment of the Mersey Tunnel, and he has recently specialized in the design of electric motors for use in oil refineries.

Mr. S. Andrew has been appointed assistant superintendent, Transformer Department, Metropolitan-Vickers, and **Mr. K. M. Miller,** A.M.I.E.E., is assistant superintendent, "G" Aisle Department.

Mr. Andrew joined the company for training in 1924 and subsequently has held various positions up to general foreman, Transformer Department.

Mr. Miller joined M-V as a school apprentice in 1953 and attended the College of Technology, Manchester, and the Royal Technical College, Salford. In 1938 he entered the Motor Engineering Department. He has spent a considerable time on the development side of that department, specializing in insulation problems, and he was appointed insulation and materials engineer early this year.

As from 1st September, **Mr. D. B. Clark,** A.M.I.E.E., has been appointed assistant manager, Glasgow office of M.-V., and **Mr. A. L. Fuller,** A.C.G.I., A.M.I.E.E., becomes assistant manager, London office.

Mr. Clark joined the company as a college apprentice in 1937. During the war he served in the Royal Electrical and Mechanical Engineers, attaining the rank of major. Returning to Trafford Park in 1946 he joined the Switchgear Sales Department, but transferred to the Glasgow office in 1952.

Mr. Fuller went to M.-V. in 1925. After a college apprenticeship at the Trafford Park works he served for a short period on outside erection work and then with the General Engineering Department, and in 1934 he joined the London District office staff as sales engineer. He was appointed assistant to the manager, London office, in 1954.

The London Transport Executive has appointed **Mr. A. H. Grainger** to the post of deputy chairman from 1st October, consequent on the retirement of **Mr. J. Cliff** on that date. Mr. Grainger joined the Metropolitan Railway in 1913 and has been a full-time member of the London Transport Executive since its formation in 1948.

Mr. E. Metcalf, A.M.I.E.E., previously deputy power station superintendent of Newton Abbot power station, South Western Division, C.E.A., has been appointed deputy power station superintendent at East Yelland power station.

At a general meeting of the **Electrical Trades' Commercial Travellers' Association** held on 9th September at the Feathers Hotel, Broadway, Westminster, S.W.1, a presentation of a collar and jewel was made to the president, Mr. Arthur T. Haywood. Mr. C. Elvy, a trustee of the Association, in making the investiture, recalled that the founders of the Association had from the start invited leading members of the industry to be their presidents and vice-presidents. Mr. Haywood, in reply, said he was fully conscious of the honour of being president of the Association. Not only was he the first Birmingham president but he was also the first to receive the presidential regalia. Mr. J. H. Bowen, the chairman, expressed thanks to presidents and vice-presidents for their support.

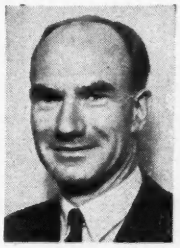
Mr. J. H. Bowen (chairman), Mr. A. T. Haywood (president) and Mr. C. Elvy (trustee) of the Electrical Trades' Commercial Travellers' Association at the presentation of the collar and jewel to the president

Mr. W. Steven, Ph.D., has been appointed superintendent of the development and research department laboratory of the Mond Nickel Co., Ltd., Birmingham, in succession to the late Mr. Howard Evans. Dr. Steven joined the Mond Nickel Co. in 1947 as a research metallurgist and in May, 1954, was appointed principal assistant to the superintendent.

Mr. A. Walsh

Mr. S. Andrew

Mr. K. M. Miller



Mr. D. B. Clark

Mr. A. L. Fuller

Mr. A. Bailey receives the Hugo Hirst Cup from the Hon. Mrs. Leslie Gamage at the recent G.E.C. annual golf meeting. Mr. Leslie Gamage is on the left

The Eastern Electricity Board has appointed **Mr. R. W. Palmer** of Ipswich as information officer in succession to **Mr. C. L. Darbey,** who has taken up an appointment with the United Kingdom Atomic Energy Authority. A former member of the staff of the *East Anglian Daily Times* and at one time the editor of the weekly papers published in Ipswich, Mr. Palmer was also Ipswich and District representative for many years of the Central News. He became assistant secretary of the Eastern Electricity Consultative Council seven years ago.

At a board meeting held on 21st September the directors of W. H. Allen Sons & Co., Ltd., elected **Mr. W. Kenneth G. Allen** to be chairman of the company in succession to his uncle, the late Sir Richard W. Allen, C.B.E., D.L. Mr. Allen joined the board in 1937, becoming a managing director in 1946, and is the third member of the Allen family to become chairman of the company since it was founded by his grandfather, Mr. W. H. Allen, in 1880.

The **Electrical Industries Benevolent Association,** Essex Branch, held a golf meeting at the Thorpe Hall Golf Club, Southend, on 13th September. The principal competition was for the Metropolitan Cup and Replica, and was won by Mr. W. A. Heythornthwaite of the Eastern Electricity Board, Brentwood. Mr. T. C. Johnston, of the Metropolitan Electric Cable & Construction Co., Ltd., was second and Mr. D. H. Robins was third. The afternoon competition, a four ball greensome against bogey, was won by Mr. K. J. Bunch and Mr. D. H. Robins; Mr. L. A. Cane and Mr. C. E. Goldsmith finished second.

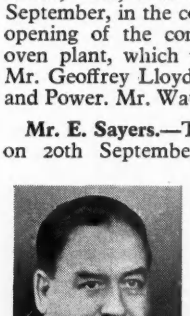
The **G.E.C. Annual Golf Meeting** was held on 17th September at Sonning Golf Course and was followed by a dinner attended by some fifty people, Mr. R. E. Robinson, director of the G.E.C. telephone, radio and television works, taking the chair. Top event of the day was the match for the Hugo Hirst Cup, won by Mr. A. Bailey (Reliance Telephone Co.), with Mr. P. C. Amberg (Express Lift Co.) runner-up. Two other events were the A. S. Black Trophy for the best scratch score, won by Mr. A. MacGregor (Glasgow Branch), and the Australia Cup for senior veterans, won appropriately enough by Mr. T. Morgan, managing director, B.G.E.C., Australia. Mr. Leslie Gamage and Mr. F. Winstanley were present at the meeting, at the end of which the Hon. Mrs. Leslie Gamage presented the prizes.

The Midlands Branch challenge golf trophy of the **Electrical Trades' Commercial Travellers' Association** was competed for at the Moor Hall Golf Club, Birmingham, recently. There was a good entry for the competition and a large number attended the presentation and dinner in the evening. The prize winners were:—First, Mr. G. W. Arnold; second, Mr. H. R. T. Ball; and visitors' prize, Mr. L. Evans.

OBITUARY

Mr. Arthur Watson, assistant managing director of Stanton Ironworks, Ltd., died suddenly on 22nd September, in the course of the official opening of the company's new coke oven plant, which was performed by Mr. Geoffrey Lloyd, Minister of Fuel and Power. Mr. Watson was sixty-two.

Mr. E. Sayers.—The death occurred on 20th September, at the age of seventy, of Mr. Edmund Sayers who, until he retired in January, 1953, was manager of the Aero Equipment Sales Department, at Coventry, of the British Thomson-Houston Co., Ltd. He completed forty-eight years' service with the company. Mr. Sayers joined the B.T.H. Co. in the Meter Test and in 1910 he was transferred to the Supply Department, Rugby, which was then the organization handling the sales of meters and instruments. Later the company sent him to various European countries, and to South America and Australasia, as foreign export representative. When at the outbreak of the 1914-18 war it was decided to concentrate the resources of the Coventry factory on the manufacture of high-tension magnetos for aircraft, Mr. Sayers gave assistance on new magneto designs. In 1932 he was appointed manager of the department later known as Aero and Auto Equipment Sales. Mr. Sayers was active in the affairs of the Society of British Aircraft Constructors and he was a Freeman of the City of London, and Liveryman of the Worshipful Company of Coachmakers and Coach Harness Makers.

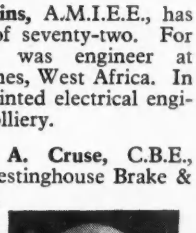


The late Mr. E. Sayers

Mr. S. Miller, who served the Sloan Electrical Co., Ltd., for forty-three years, for most of that time in the capacity of a sales representative, until his retirement in 1948, died on 21st September after a short illness.

Mr. John Jenkins, A.M.I.E.E., has died at the age of seventy-two. For many years he was engineer at Ashanti Gold Mines, West Africa. In 1922 he was appointed electrical engineer at Bedwas Colliery.

Alderman H. A. Cruse, C.B.E., director of the Westinghouse Brake & Signal Co., Ltd., whose death we briefly reported last week, retired from his executive post as general works manager in 1954 after fifty-three years of service to the company. He commenced his career with Evans O'Donnell & Co., Ltd., at the Chippenham works, later taken over by Saxby & Farmer, Ltd., and afterwards incorporated in the Westinghouse organization. He worked in Progress Control, became assistant works manager, joint works manager, and in 1936 general works manager; he was elected to the board in 1944. Ald. Cruse was Mayor of Chippenham for three years. He also served several terms of office as president of the Engineering and Allied Employers' West of England Association, was a member of the management board of the Engineering and Allied Employers West of England Associa- Employers' National Federation, a Signal Engineers, and a member of the Institute of Industrial Administration.



The late Ald. H. A. Cruse

Mr. W. R. Durtnall.—The death has occurred of Mr. W. R. Durtnall, manager of the Electrical Installations Department of Burdette & Co., Ltd. Mr. Durtnall had been with the company for thirty-five years.

Mr. F. Baker, for the past 5½ years southern area capacitor engineer for the Bryce Electric Construction Co., Ltd., died on 16th September at the age of fifty-one.

I.E.E. Section Chairmen

New Officers for the 1955-56 Session

ON 6th October the London meetings of the Institution of Electrical Engineers for the 1955-56 Session will commence with the Presidential Address by Sir George Nelson, Bt., and a number of the Provincial Centres will start their programmes a few days earlier. The portrait and biographical notes of the President were published in our issue of 22nd July, and we now publish photographs and notes of the men who will preside over the meetings of the specialized Sections. In following issues we hope to deal similarly with the chairmen of the Provincial Centres.

MR. W. BAMFORD, B.Sc. (Measurement and Control Section) is director of sales with Everett, Edgcumbe & Co., Ltd. He was educated at Wigan Grammar School and graduated in electrical engineering at Manchester University. After a period of seven years with Ferguson Pailin, Ltd., Manchester, during which he was engaged on contracts engineering (heavy metal-clad switchgear) and sales engineering, he joined George Ellison, Ltd., in 1934 as sales and contracts engineer, and left that company in 1936 to take up the position of chief sales engineer with Everett, Edgcumbe & Co., becoming also director of sales in 1950. Among his many activities in the electrical industry, Mr. Bamford is vice-president of the Society of Instrument Technology and a member of the Council of the Scientific Instrument Manufacturers' Association, of which he was treasurer for 1954-55 and for several years vice-chairman of the Export Panel. He has also served on several committees and is a member of the Standing Committee of the Instrument Section of the British Electrical and Allied Manufacturers' Association and a member of a number of committees of the British Standards Institution. Mr. Bamford has taken a close interest in the development of graphic recording instruments and has made various reports and taken part in discussions on the subject.

Mr. W. Bamford

Mr. H. Stanesby

Mr. L. Drucquer

Mr. D. B. Hogg

MR. H. STANESBY, C.G.I.A. (Radio and Telecommunication Section), was educated at Emanuel School, Wandsworth Technical Institute and London University (part time). He entered the Post Office Engineering Department in 1924 and was successful in the inspectors' competition in 1925 and the assistant engineers' competition in 1930. In 1938 he was promoted to executive engineer, in 1947 became assistant staff engineer, and in 1951 staff engineer. In his early days Mr. Stanesby was closely concerned with the first transatlantic telephone, and with the development of radio receivers for long-distance commercial communication. Later he played an important part in developing multi-channel telephone and television systems for coaxial cables. In 1951 he assumed charge of the radio laboratories at Dollis Hill, and in 1952 he was transferred to the City in charge of the Radio Planning and Provision Branch of the Engineering Department.

Mr. Stanesby has written many articles, notably on electric-wave filters, and in 1952, jointly with Messrs. Kilvington and Laver, he was awarded the Ambrose Fleming Premium of the I.E.E. for a paper on the London-Birmingham television cable system. In 1953, on its foundation, he was given the City and Guilds Insignia Award for Technology. He is chairman of Study Group IX of the International Radio Consultative Committee, and vice-chairman of a joint study group of the International Radio/Telegraph Consultative Committee, and has represented the United Kingdom and the International Radio Consultative Committee at a number of international conferences.

MR. L. DRUCQUER (Supply Section) is manager, home sales, with the British Thomson-Houston Co., Ltd., and is also a director of the Switchgear Testing Co., Ltd., and E.R.A. Patents, Ltd. He received his general education at the Haberdashers' Aske's School, and his early technical training at the Polytechnic Engineering College, London, being awarded a diploma in electrical and mechanical engineering. He joined the B.T.H. Test Department in 1920, and in 1923 was transferred to the outside construction staff. He joined the Switchgear Sales Department in September, 1925, becoming assistant manager in April, 1939, and manager in January, 1945. During his association with switchgear sales Mr. Drucquer was responsible for many contracts for factories, railways and power stations at home and overseas, as well as switchgear for several area schemes for 132 kV and 66 kV sections of the grid.

MR. D. B. HOGG, M.B.E., T.D., F.I.E.S. (Utilization Section) was educated at C.I.M. Schools, Chefoo, North China, and received his technical education at the College of Technology, Manchester. He served an apprenticeship with Mather & Platt, Ltd., and had subsequent training with that company. From 1917 to 1919 he was in the London Electrical Engineers R.E. (T) Searchlights. In 1927 he joined Synthetic Ammonia Nitrates, Ltd. (now I.C.I. Billingham Division), and was employed as electrical engineer on construction, plant maintenance and factory design. He transferred to the head office, engineering section, I.C.I., in 1938 and during the last war served in the Royal Artillery and Royal Engineers, attaining the rank of lieut.-colonel R.E. as A.D.W. (E. & M.), H.Q. 21 Army Group, seeing service in France and Germany. On demobilization, Mr. Hogg went to the new I.C.I. Works at Wilton, first as the senior electrical engineer, design, and later as electrical manager and distributed services manager; he recently became staff manager.

"Epikote" Resins

Shell Chemicals Plant at Stanlow

ON 13th September Shell Chemicals, Ltd., demonstrated to the Press their recently completed plant at Stanlow for the production of "Epikote" resins. These are a new type of condensation polymer, clear amber coloured liquids or solids made by reacting diphenylol propane (D.P.P.) with epichlorohydrin (E.C.H.) in the presence of caustic soda solution. Their advantages are toughness and flexibility, adhesive ability and resistance to chemicals and water. The principal uses are in the realm of surface coatings for domestic appliances, floorings, cars, chemical plant, etc.; and a growing application for the "potting" of electrical equipment such as transformers or small assemblies. The good mechanical and electrical properties of the cast resins, together with their low shrinkage during cure, make them very suitable for this class of work. Seven grades are produced in the Stanlow plant, differing in the length of the molecule chain. The shorter chain resins are syrupy liquids and the longer chain ones are solids.

Method of Production

The reaction of D.P.P. and E.C.H. takes place with the evolution of heat, and after stirring for a period the material is allowed to settle. The upper water layer contains salt and is skimmed off and the "taffy" or reaction product is carefully washed with very pure water to remove traces of inorganic chlorides. After the reaction, the dry molten resin is run out into stainless steel trays where it solidifies. The resin is broken up into fairly large pieces and is then passed through a crushing machine to ensure a consistent size of particle.

The crushed resin is blended in a vertical conical mixer in which an upward lifting screw conveyor rotates and progresses with a gyratory motion. The blended material is packed by machine into strong paper-lined sacks to a standard weight. The sacks of finished resin are stored on pallets according to grade. For the liquid grades the solvent-free liquid resin is filtered through a horizontal leaf filter direct into drums.

D.P.P. is made in an ancillary plant at Stanlow and is stored in drums until required for use or for sale. Particular attention was paid to the design of drum filling apparatus to avoid the formation of dust. Imported E.C.H. is received in drums and is decanted and stored in bulk until required. The quantity of this component required for a reaction is either weighed out, using a stainless steel vessel permanently positioned on a large scale, or for the liquid grades is measured into the reaction stream by a pre-set automatic cut-off displacement meter.

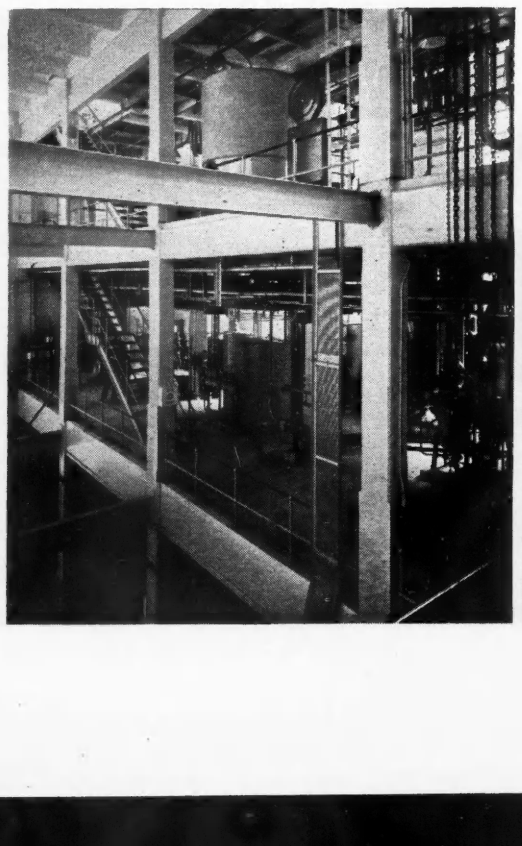
Automatic Control

The plant is equipped, wherever possible, with controllers which in some cases determine the temperature and control the flow of heating material accordingly, or in other cases determine automatically the acidity of the wash water and give an alarm if a certain value is exceeded. These automatic instruments allow the number of people employed on the plant to be kept to a minimum.

The heart of the plant is two large reactors, each of which is of all welded stainless steel construction. Each of the reactors is equipped with a massive anchor-type stirrer the blades of which are cast from stainless steel, while their shafts are of mild steel clad with stainless steel. Each stirrer is driven by an 83 h.p. motor coupled to the shaft by a variable speed hydraulic drive. The plant has been so designed that two similar reactors can be installed in order that the increasing demand for these resins may be met.

The wash water is introduced below the "taffy" level and is drawn off up a pipe which is controlled so that it is just below the surface of the liquid. A slight positive pressure applied to the vessel causes the wash water to rise through the "dip" pipe. One of the reactors will normally be used for the production of liquid grades and either can be used for solid grades.

Considerable pains have been taken to ensure that the quality of "Epikote" resins is uniform throughout the world, and special equipment has been imported from Holland, Switzerland and the U.S.A. so that standardized results may be obtained.

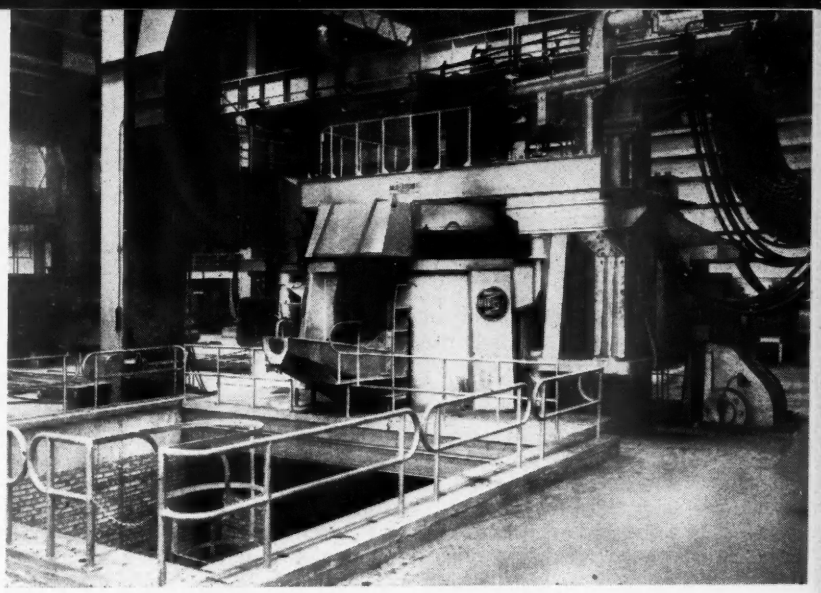


General view inside the Stanlow plant of Shell Chemicals, Ltd., and (below) motors and hydraulic drives for kettle stirrers

Electric Arc Furnaces

Techniques of Controlling A.C. Direct Arc Units

By F. D. GUNTON, B.Sc., A.M.I.E.E. and O. S. STEELE, B.Eng.*



Large Birlec furnace with B.T.H. electrode control

A GREAT deal of interest has been shown in recent years in the a.c. arc furnace and particularly since the publication of the Battelle Report in July, 1953. Articles on the economics and the mechanical design and steel making aspects of arc furnaces have appeared in this and other publications and the present article is intended to deal with the a.c. direct-arc furnace from the point of view of the control problem which it presents.

Electric arc furnaces are used for melting and refining a wide range of metals. The same arc furnace is often employed to produce alloys of differing composition, and very precise metallurgical specifications can be met. It is thus regarded as a most powerful tool in the metal industry, either alone, or in combination with other processes.

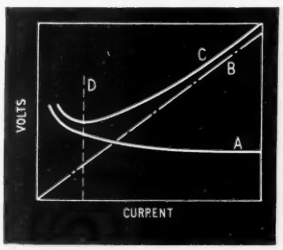


Fig. 1.—Arc characteristics at constant arc length

The electric arc furnace presents some interesting problems in the fields of power supply, power transformation, switchgear and control apparatus. Some of these problems affect chiefly the designer and manufacturer of electrical apparatus; others are of equal importance both to the apparatus designer and to the user. From the user's point of view, the number of factors under his control give the possibility of very exact control of the product. On the other hand, this very flexibility means that the user must choose his working techniques to take the utmost advantage of the various adjustments available in relation to the metallurgical and economic results obtained.

The furnace may take various forms, but the three-phase direct-arc electric furnace of the "Heroult" type (built by various furnace makers in several forms) is the one most widely used in foundries. This type is supplied with power through graphite electrodes supported on vertically movable electrode arms, the electrodes and their supporting arms being raised or lowered either by a hydraulically operated piston or, through a system of pulleys, by an electrically operated winch. The hydraulic system or the winch motor is controlled by an electrode regulator which will be described below. An operator's control panel is placed near the furnace.

* The authors are with the British Thomson-Houston Co., Ltd., Rugby.

There are usually three electrodes, and the charge itself forms the neutral point. It is not usual to connect the charge back to the furnace transformer—thus the neutral is usually "floating" relative to the furnace transformer output. However, the furnace shell is usually earthed thus effectively earthing the charge through the refractory lining.

Power to supply the arcs is obtained from a transformer generally placed close to the furnace and is supplied to the electrode arms by means of heavy copper busbars and flexible cables so that the electrode arms are free to move. The amount of movement required has not only to allow for change of arc lengths in response to required changes in arc current, but also has to accommodate the change in configuration of the pile of loose pieces of scrap metal as it melts down to liquid and has, in addition, to allow for relative movement of shell and roof in the case of a top-charged furnace. A three-phase reactor is generally placed in the same tank as the transformer and is connected in series with the h.v. supply to the transformer. The function of this is described later.

Switching of the furnace is always done on the h.v. side of the transformer. The same switch often fulfils the functions of both furnace switch and protective circuit-breaker, although there are installations where separate switches, with suitable discrimination, are used for the two duties. References [1, 2, 4] may be consulted for further information regarding mechanical construction.

Principle of Working

In operation, the electrodes are lifted clear and the furnace is filled with scrap. When the furnace is switched on the electrode regulator automatically lowers the electrodes. When the current begins to flow, each regulator is automatically raised to draw an arc whose length is controlled to maintain as closely as possible the desired current. Actually, in most modern regulators the control operates to keep a constant arc *impedance*. That is, the ratio of arc current to arc voltage is the quantity which is kept constant by the electrode regulator. As far as the furnace operator is concerned, pure current control and impedance control would come to the same thing under steady conditions, but impedance control has advantages during the melting-down stage.[7]

It is necessary to connect reactance in series with the transformer in order to stabilize the arc, as the characteristic of the arc itself is negative, i.e., the arc impedance

decreases as the current increases. In Fig. 1 curve A shows how the arc voltage drop decreases as the current is increased. An impedance with a positive characteristic such as a reactor will show a voltage drop proportional to the current as shown at B. If the two are combined, as for example, if the reactor is placed in series with the arc, the combined impedance will be shown at C, which is stable beyond point D. Increasing the length of the arc has the effect of increasing arc impedance thus reducing current and it is on this principle that arc furnaces are controlled.

The furnace is normally operated with maximum transformer secondary volts until "flat bath" conditions are approached when it is advisable to reduce the arc length in order to avoid overheating the roof of the furnace. This is accomplished by reducing the transformer secondary voltage by tap changing. When melting is complete it is usual to start refining which may require the power input to the furnace to be reduced to the point where the power input just supplies the furnace losses. This is accomplished by again reducing the transformer secondary voltage by tap changing and also reducing the electrode current setting to one fifth or less of the normal full load current. Controls to carry out these adjustments are situated on the operator's panel.

Load Characteristics

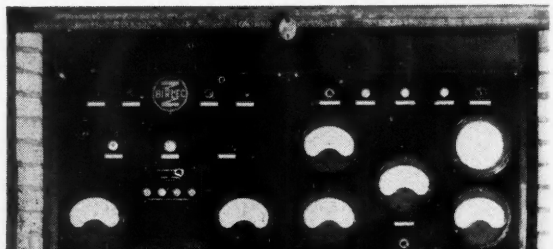
The electric arc furnace imposes a violently fluctuating load on the power system and unless special care is taken in obtaining a suitable supply objectionable voltage fluctuations will occur and undoubtedly give rise to complaints from other power users. It is proposed to examine the causes of the peculiar conditions pertaining to the supply of power to arc furnaces and point out how disturbances can be minimized.

On switching on the supply, the three electrodes move downwards. When the first one touches the charge it stops, and when the second electrode touches a large single-phase current of low power factor flows, its magnitude being dictated by the sum of the impedances of the supply, the transformer, the reactor and the connections between transformer and electrodes. (This usually limits current to about three times the full load current of the transformer.) The electrode regulator should then withdraw the electrodes concerned as rapidly as possible thus drawing two arcs, one between each electrode and the charge. The third electrode will touch the charge and draw a third arc, the peak current in this case not being quite as large as the initial surge.

The arc should be drawn as quickly as possible in order that the duration of the high current will be short, and the electrode current should subsequently be kept fairly constant so that the arc is not extinguished necessitating another restrike with its accompanying surges.

After the furnace has been in operation for a time, the electrodes will have "bored" into the scrap, i.e. melted the scrap locally to form deep craters, and the surrounding scrap may then collapse on to the sides of the electrodes, thus causing excessive current to flow. The electrode regulator must then raise the electrodes at top speed in order to keep the duration of the surge as short as possible.

A good regulator can reduce the frequency and duration of the surges but it is not possible to completely eliminate them. The effect of these on other consumers depends on the characteristics of the supply system and in some cases a separate feeder is obviously desirable. Gaunt[3] points out that arrangements have sometimes to be made to avoid interference in the supply to other



Operator's control panel. (Photo by Birlec, Ltd.)

loads on the same consumer's premises. If at all possible, the supply to a large furnace should be on a separate feeder so that the impedance common to the supply to the furnace and that to other consumers is as small as possible. The reactance of the furnace transformer, reactor, etc., should be such as to limit the maximum current surge to a reasonable value, generally not more than three times the furnace transformer rating.

It will be appreciated from the above that the arc furnace produces power fluctuations of considerable magnitude which are reflected back to the supply authority's equipment and will affect other loads unless the special precautions mentioned above are taken. The effects may be noticed mainly in lamp flicker or there may be other equipment such as instruments on the same premises whose operation may be affected and operation of office calculating machines has been reported[3] to be upset. In certain cases it might be advantageous to supply equipment of this kind through constant voltage transformers which effectively smooth out the voltage fluctuations.

Reactance and Power Factor

Although the arc furnace is a heating load the power factor of the installation is not unity as there must be sufficient reactance in the circuit to stabilize the arc as previously explained, this reactance also serving to limit the current on surges.

The connections between transformer secondary and electrodes may have an inherent reactance, referred to the primary, of about 15 per cent at lower voltage taps, but the effect of this reactance is less at higher voltage taps and, as has already been stated, a tapped reactor (of say 15 to 30 per cent reactance, i.e., the voltage drop across the reactance at rated full load current is equal or equivalent to the stated percentage of the transformer primary voltage) is inserted in the supply to the furnace transformer. Some foundry operators maintain that there is an optimum amount of reactance which can only be

ascertained by experience, and which gives the best "quality" of arc for melting.

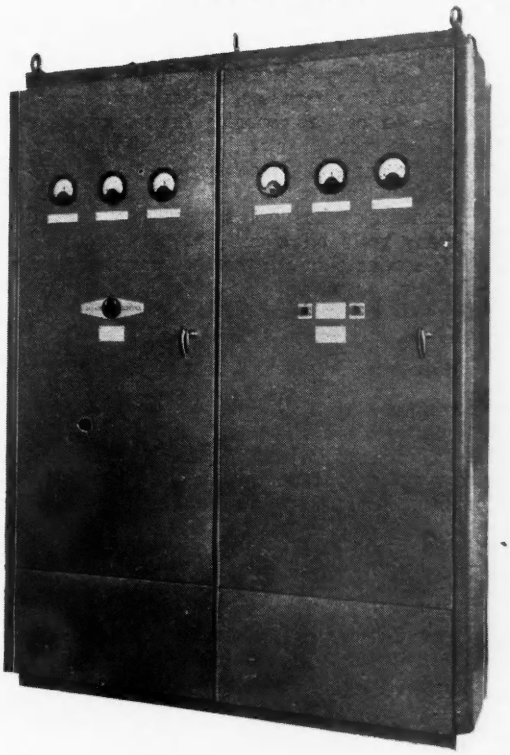
Addition of reactance of course reduces the power factor so that it is important that the amount to be used should receive careful consideration, based on the following points:—(1) Amount of reactance necessary to stabilize the arc. (2) Amount of reactance necessary to reduce current surges to reasonable values. (3) Optimum amount of reactance for good melting arc. (4) Undesirability of and penalties for low power factor. (1) and (2) call for high reactance. (3) is a matter of the furnace operator's preference as a result of experience, as has already been indicated. (4) calls for low reactance.

In passing, mention might be made of the "maximum power" conditions whereby, for a given setting of reactor and tap changer, if current is increased more and more into the over-current region the power input to the furnace rises to a maximum before commencing to diminish again. It is a phenomenon met with in all types of load where current is adjusted by variation of load impedance. This characteristic of the arc furnace load is discussed more fully in the appendix.

Maximum Demand Equipment

It is becoming increasingly desirable to employ some type of maximum demand limiting equipment throughout industry as more use is made of tariffs based on maximum demand, and the arc furnace lends itself to the overriding control of such equipment without difficulty as the power input to the arc furnace is generally large in proportion to the demand of other equipment generally found on the same premises and also because the process is not seriously affected by the speed of melting. However, it should be appreciated that the operation of such equipment will increase power consumption per ton of metal melted as the heat losses are increased if the time taken to melt is extended.

Cubicle housing control panel



Very small furnaces are often operated by hand control, that is, the operator by watching the ammeters moves the electrodes manually to keep the current approximately constant. On larger furnaces, arrangements are usually made for the operator to control the electrode movement by hand control switches in an emergency, but the response of the human operator cannot be sufficiently fast to cope with current changes and produce rapid and economical melting.

Automatic Control Schemes

Over the period in which arc furnaces have been in use many different methods of automatically controlling the current in the arc have been tried. They all essentially consist of providing a regulator which is directly or indirectly responsive to the arc current and raises or lowers the electrode in response to the dictates of the regulator. The original regulators were designed to operate purely on the current in the arc but better results have been obtained by regulators which attempt to maintain the arc *impedance* constant (as previously explained) and practically all modern types of regulator work on this principle.

The contactor system of control has worked well for many years and provides a simple method of automatic control. The control for each electrode essentially consists of a balanced beam relay with a voltage coil on one side of the beam carrying a current proportional to the arc voltage and a current coil on the other side carrying a current proportional to the arc current. The beam has contacts so that if it tips one way it operates one of a pair of reversing contactors and if it tips the other way it operates the other contactor. The reversing contactors supply a d.c. motor which drives a winch to raise or lower the electrode concerned. Thus if the arc current is excessive the current coil on the beam relay attracts the beam thus closing contacts which pick up the contactor which rotates the winch motor in such a direction as to raise the electrode. In the de-energized position of the motor contactors, dynamic braking resistance is usually inserted. There are various methods of ensuring that the motor does not cause the electrode to overshoot the correct position. One method is to interrupt intermittently the signal as the point of correct impedance is approached; thus the electrode approaches its correct position by a series of steps.

The chief disadvantages of the contactor scheme are (1) slow speed of response as it is necessary to place buffer resistance in series with the motor armature, (2) a delay of 0·15 to 0·2 sec between a disturbance occurring and energizing of the motors due to the time taken to operate the relay and contactor, and (3) an appreciable amount of maintenance because of the very severe duty on the control gear.

Hydraulic Control Systems

In the various hydraulic control schemes a hydraulic cylinder is arranged to operate directly on the electrode arm and the supply of oil to this cylinder is controlled by a pilot valve which in turn is controlled directly or through the medium of relays from an impedance responsive circuit similar to that described for electric contactor control. The pilot valves may be mounted in the stationary part of the installation or they may be mounted as part of the main operating cylinder assembly. Characteristics of hydraulic control are small effective inertia of mechanical parts and the availability of high values of maximum

electrode speed. Special care must, of course, be taken to avoid leakage of the hydraulic fluid and it should ideally be of a non-inflammable nature.

"Rotary" Control Systems

The modern method of electric control is based on the Ward-Leonard principle, a generator being energized by the control signal (derived from the arc voltage and current). The motor, which is separately excited from a constant voltage, then moves in response to the generator voltage, giving what is sometimes known as "proportional" control; i.e., the speed of the motor, and hence the speed at which the electrode moves towards the desired position is proportional to the deviation from the required position. This has the advantage of minimizing the effect of the motor inertia as the correct position is approached at low speed. Automatic regenerative braking is inherent in this scheme, the rotational energy of the motors being returned to the supply during retardation.

If a normal generator is used in the above way, action tends to be sluggish due to the time constant of the generator field and the electro-mechanical time constant of the motor.

If in the above scheme the generator is replaced by or excited by a rotating amplifier (e.g. an amplidyne) several modifications of the circuit are possible in addition to the inherently fast action of the amplidyne itself to force the effective time constant of the system down and tests on a direct amplidyne scheme indicate that the motor will start to move in 0·035-0·05 sec and reach 63 per cent of maximum speed in approximately 0·15-0·22 sec. Fig. 2 shows that if a small adjustment in electrode position is required the amplidyne regulator will make the adjustment before the hydraulic regulator but that the hydraulic regulator has the advantage where a large adjustment is required. However, as the arc is very short, most adjustments are small and it has been found that a relatively low maximum electrode speed is satisfactory provided the rapidity of response is good. Thus it is possible to use electrode speeds of 4-6ft/min with an amplidyne regulator and the performance will be as good as or better than that with a hydraulic regulator in spite of the higher electrode speeds of the latter. High electrode speed of course increases the possibility of electrode breakage.

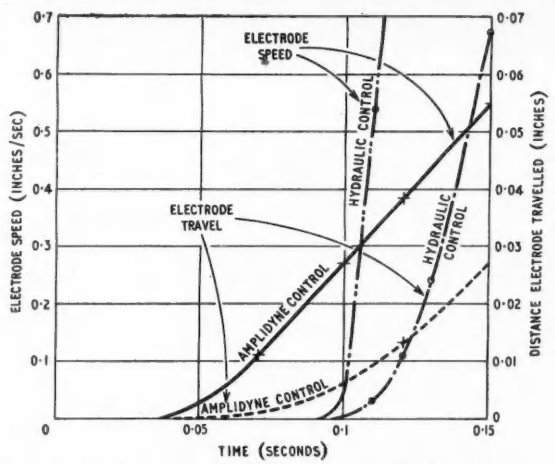
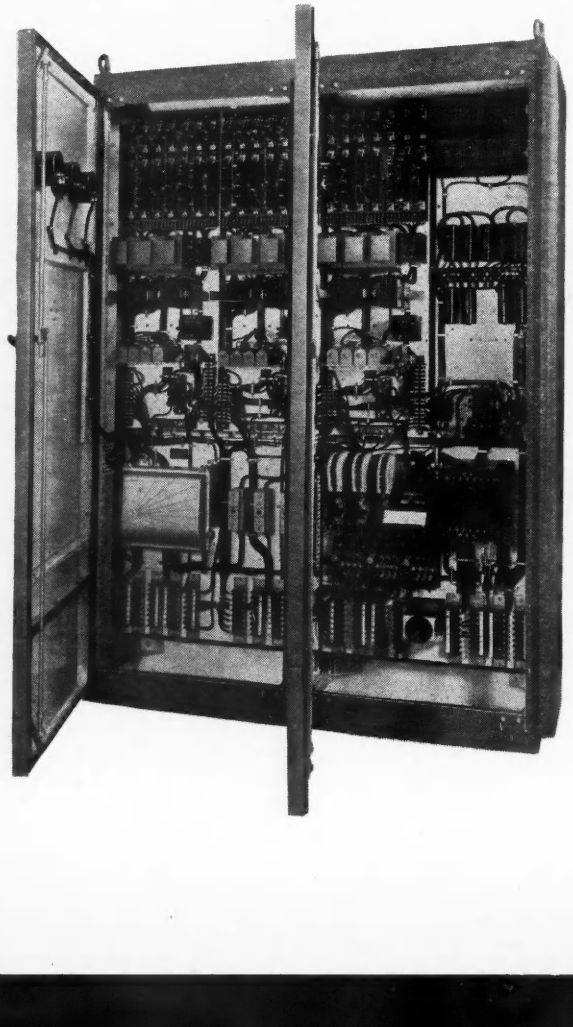


Fig. 2.—Curves showing response of amplidyne and hydraulic regulators to a signal

Interior of cubicle showing three readily detachable electrode panels and supply panel



Switchgear

The transformer is usually supplied through an oil circuit-breaker although the duty is a difficult one for this type of switch. The service required of a suitable breaker involves the following conflicting duties: (1) Frequent making and breaking of transformer magnetizing current as required for tap changing, unless the transformer is designed for on-load tap changing, (2) occasional overload tripping which may occur at the start of a melt or when "cave-ins" occur and (3) ability to clear a transformer fault if it should occur. This may require a high MVA rating depending on the supply system.

For many years oil circuit-breakers have performed the above service although they are essentially designed for infrequent operation. However, it is usually found necessary to filter the oil and service the contacts at regular intervals, usually monthly.

Several alternative schemes have been tried with considerable success but the increased capital investment has been an obstacle to their more widespread use. One scheme uses a h.v. contactor in conjunction with the oil circuit-breaker, the contactor performing all the usual furnace switching functions while the oil circuit-breaker provides back-up protection. Another scheme uses an air blast circuit-breaker but the first cost of such a breaker is high. Some notes on air blast breakers used in conjunction with arc furnaces have previously appeared in the *Electrical Review*[6].

The Transformer

The furnace transformer is especially designed for the service as abrupt fluctuations and heavy currents require a robust construction. The rating of the transformer is generally within the range of 250 kVA-1,000 kVA

per furnace rating ton. The trend has been towards the higher figure for the smaller furnaces and about half this for the larger furnaces. The greater input can be used to reduce the melting time but it may increase the overall power costs especially if maximum demand penalties are in force. Experimental work is being done particularly by the British Iron and Steel Research Association[5] to investigate the effects of high power input rates.

The primary of the transformer is usually arranged for star or delta connection and the changeover therefore effectively doubles the number of voltage taps available: thus usually 4-6 taps are provided on the primary winding and there are then 8-12 different voltages available. However, the tap changer (usually of the off-load type) generally has a limited number of positions (say 4-6), with the transformer and reactor taps selected at the various positions being preset by links.

The secondary voltage is generally within the range 150 to 225 V between electrodes but recent practice has been towards substantially higher voltages for the very large furnaces in order to keep the size of the electrodes down.

The type of cooling will depend on conditions existing on site. However, most transformers are oil filled, the oil being air cooled, or oil filled water cooled depending on size, the larger ones generally being water cooled. The transformer is sometimes placed in a small room and it is often difficult to ventilate such a room properly when it takes the form of a house situated in the midst of a foundry, so that a water cooled transformer is the attractive alternative in this case.

Protective Schemes

Furnace transformers require protection against overload and against faults. The overload protection is thermal and either depends on the actual temperature of certain selected points in the transformer or is based on creating a thermal image of the transformer, by such an arrangement as the bulb of a dial type thermometer being surrounded by a heating coil in the top transformer oil, carrying a proportion of the load current so that the temperature of the bulb is a good approximation to the temperature of the transformer.

Fault protection generally takes the simple form of an inverse time overload relay set so that it trips the circuit-breaker if the current should rise beyond certain preset limits for a time depending on the magnitude of the current. However, the settings required for this simple arrangement to give satisfactory protection for fault conditions are generally such as to cause trips on cave-ins and even after a period of heavy load within the overload capacity of the equipment. The Buchholtz relay, which depends upon the accumulation of gas bubbles inside the transformer tank to lift a float, may be used to give protection against a transformer fault. Alternatively two inverse time overcurrent relays may be used, one set high on overcurrent but of short time delay to give protection against a transformer fault, and the other set to give protection to the transformer against a sustained overload such as "cave-in."

A number of studies have been made of the comparative cost of steel making and the electric arc furnace has shown up well compared with the open hearth furnace when conditions are favourable. There seems to be no doubt that it will produce an increasing proportion of the nation's steel output in the years to come.

The authors wish to express their thanks to the British Thomson-Houston Co., Ltd., for permission to publish this article.

APPENDIX

Characteristics of the Arc Furnace Load

At Constant Arc Length.—There are many factors, constantly varying, which will affect the precise characteristic at any instant, particularly during the period when solid material is being melted down. However, the volt-ampere characteristic of the arc furnace installation at constant arc length is indicated generally in Fig. 1 and described in the text under the heading "Principle of Working."

At Constant Transformer Tap, Constant Reactance Varying Arc Length.—Let us consider the arc furnace installation in the simplified form of an arc of variable length connected in series with a reactor to a source of constant voltage. This will represent approximately the action of one electrode of the furnace when the furnace is running steadily, all phases balanced.

In this simplification, the effective reactance of the charge, busbar and flexible cable connections and transformer reactance are thought of as lumped into the reactor, and I^2R losses in the transformer and busbars are neglected.

The volt drop across the arc, being resistive, can be taken as being in quadrature with the volt drop across the reactor and the vector diagram takes the form of the triangle EFG in Fig. 3, where EF is the supply voltage, EG the drop across the reactor and GF the arc voltage, the power factor of the load being cos ϕ. Since EGF

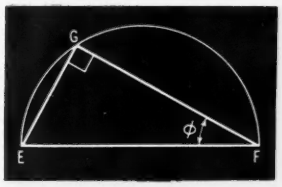


Fig. 3.—Voltages across reactor (EG) and arc (GF) referred to one side of the furnace transformer EF = open circuit voltage

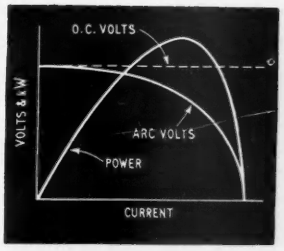


Fig. 4.—Arc volts and power curves for a given tap changer position

is a right angle, the locus of G is necessarily a semicircle on EF as diameter. For any given current, EG is fixed; EF is fixed by the supply voltage, thus for a given current GF is necessarily fixed. Thus it is possible to plot a graph of arc voltage against arc current, whose ordinates are lengths of vector GF and abscissae are proportional to lengths of vector GE. At zero current the voltage across the arc is the open circuit voltage of the supply and at short circuit the current cannot exceed a value limited by the reactance, and the arc voltage is zero. This curve is plotted in Fig. 4.

Maximum Power Condition.—If the current could be turned up high enough, at a given transformer tap and reactance setting, the power would rise to a maximum and then decrease again. It is easily seen that power input will be substantially zero at maximum possible current, i.e., with the charge short-circuiting the electrodes—the arcs would then no longer exist and the only heat being generated would be in the resistance of the charge—there would be maximum kVA into the furnace transformer, but at substantially zero power factor.

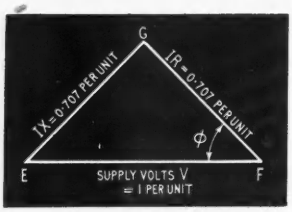
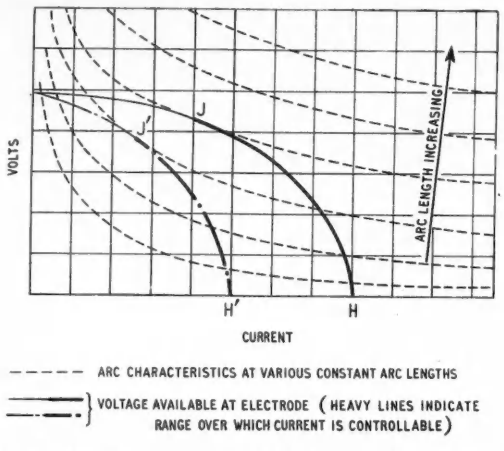


Fig. 5 (left).—Voltages across reactor (EG) and arc (GF) referred to one side of the furnace transformer at maximum power input

Fig. 6 (below).—Arc furnace operation at constant tap changer position



The value of current at which the maximum power is obtained, and the value of the power itself at this point, vary according to the total effective reactance in circuit. What *is* constant about the "maximum power" condition is that it will always occur when the power factor of the installation is in the region of 0·7 (Fig. 5 shows the vector diagram for this condition, where the reactive and "ohmic" volt-drop components are equal).

Does this mean that in order to get maximum power into a furnace within the rating of the transformer, a reactance of 70 per cent should be used? This question can be answered after a little reflection. Whatever power (kilowatts) is being obtained at the rated kVA output of the transformer the kilowatts can always be increased by running at a higher power factor, i.e., by using less reactance. (Provided, of course, that the arc remains stable.) Thus the consideration of getting maximum power within the rating of the transformer would, like consideration (4), enumerated above, under "Reactance and Power Factor," call for low values of reactance, and certainly nothing in the region of 70 per cent. In practice, if it were desired to run a normal furnace installation at the "maximum power" point corresponding to the reactance in circuit, the equipment would be grossly overloaded in the attempt.

In Fig. 6, various arc volt/ampere characteristic curves at constant arc length (similar to curve A of Fig. 1) (dotted lines) have been superimposed on the arc voltage curve (full line) for a given tap changer position, and the intersections indicate working points. From the short circuit current given by H, current can be reduced by increasing arc length until a critical length is obtained, at which the arc characteristic has a common tangent (at J) with the actual arc voltage curve. An arc of any greater length cannot be maintained, and thus the range from J to H contains the only values of current which can be maintained.

If the same transformer tap is used (giving the same open circuit voltage) but with more reactance, resulting in a smaller short circuit current, the actual arc voltage curve will be as shown by the chain dotted line in Fig. 6. The minimum current which can be maintained will correspond to J^1 and it will be seen that over the range of possible currents from J^1 to H^1 a shorter arc length is associated with a given current. The arc length for a given current is also reduced if a lower voltage tap is selected with the same amount of reactance in circuit.

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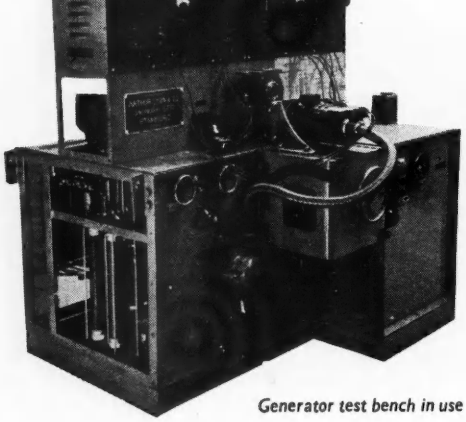


Generator test bench in use

Aircraft Generator Test Bench

Arthur Lyon & Co. (Engineers), Ltd., have developed a style of test bench for the routine testing of aircraft alternators, and they will shortly be in general production. The bench is used to test aircraft d.c. generators (normally engine driven) with outputs up to 6 kW and 28 V together with associated cut-outs and voltage regulators; and a.c. generators with outputs up to 1·2 kVA and 80-115 V and associated control panels.

The main drive motor is a B.T.H. a.c. variable speed commutator type machine of 20/1·18 h.p. and 1,700/100 r.p.m., driving a countershaft at the centre of the bench. Two double helical gearboxes give the final range of driving speeds required.

A rise and fall table operated by a handwheel is mounted in the centre front of the bench in line with the output coupling on the gearbox and enables adjustment to be quickly made for generators of different centre heights. A lever locks the table in position when correctly aligned. An air blower and flexible hose provide cooling air to the generator under test.

Separate test panels on the bench cater for the required measurements and control of d.c. and a.c. generators.

Fire Alarm Network

Up-to-Date Installation by B.O.A.C.

THE prevention of fire at airports presents many special problems. It is essential that there shall be a speedy detection system, capable of giving ample warning so that an outbreak occurring at any part of dispersed premises, can be controlled before it spreads to inflammable materials.

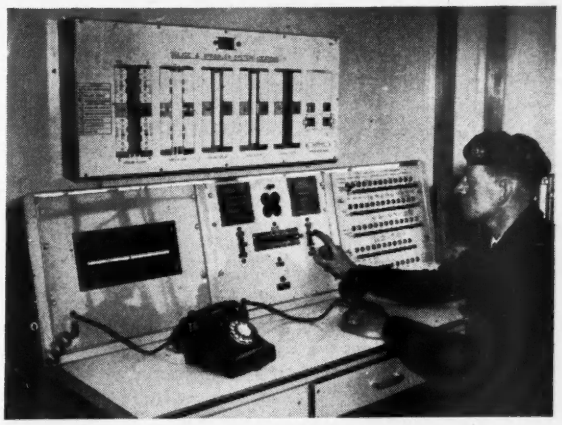
The B.O.A.C. headquarters building at London Airport is a six-storeyed construction with a frontage of 480ft and length of 840ft. Four hangars, each capable of housing three large airliners, are situated in the corners of the building, and a large repair and maintenance section runs for almost the entire length. Offices, workshops, stores and canteens are grouped at various levels, and if an alarm system is to be fully effective, it has to be coupled with several different systems of automatic fire control.

There are, in fact, four separate automatic fire control systems throughout the building—sprinklers, "Mulsifyre," deluge, and CO_2—their positioning being governed by the type of fire likely to be met with in any one section. The detection mechanisms of each of these systems have been arranged so that an outbreak at any point is instantly registered in the B.O.A.C. fire post watch room where a comprehensive alarm panel, and address equipment, are housed in a compact console. From the alarm panel it is possible to see immediately which of the automatic extinguishing systems has gone into action; and to ensure that no time is wasted in locating the exact position of an outbreak, its source is shown on a map indicator consisting of an engraved outline of the plan of each floor in the building, giving block positions, main stairways and lifts, etc. The entire building has been covered by a comprehensive network of loudspeakers, and in the event of fire a pre-recorded tape message can be broadcast from the watch room, warning people in the affected area. The operation of a key sets the tape message in motion, and the circuit has been designed so as to give the fire watch room microphone absolute priority over all others. In addition to fire and other emergency messages the p.a. equipment is also used for routine announcements.

Closed Circuit System

The alarm panel is equipped with groups of three-position control and test keys, as well as indicating lamps for the various alarms. In designing the electrical side of the installations, it was decided that the signals should operate on the "closed circuit" principle and in each line a continuous current of 28 mA is flowing. The use of the closed circuit system is particularly advantageous as it enables facilities to be included to give automatic indication of both "open" and "short" circuit faults on the lines. Owing to the complex nature of the protective devices installed throughout the building, it was very important that the alarm circuits should be fully protected against such faults. When an alarm contact is opened, instant notification is given on the particular lamp signal concerned on both indicators and by the ringing of the main alarm bell. The bell can be silenced by moving the key concerned to the "cancel alarm" position. This does not prejudice alarms from other circuits. The lamp signals in the indicators remain illuminated until the contact which initiated the signal is restored to normal and the "cancel alarm" key is replaced.

In the event of a fire breaking out in one of the hangar bays covered by deluge systems, which are normally held in the closed position by air pressure three distinct indications are registered on the fire alarm panel. These are the "low air" alarm, which indicates that the air pressure in the detector piping of one of the six systems in the hangar concerned has fallen from its normal operating pressure of 40 lb/sq in to below 25 lb—due probably to gradual air leakage. This condition causes the appropriate "low air" alarm lamp to illuminate on the fire alarm panel, and the fire post bell to sound automatically. No lights are illuminated on the map indicator.



The fire watch room control panel

The next stage in the warning, is the "very low" air alarm, which registers when the air pressure has fallen below 15 lb/sq in. If at this stage the leakage continues, there is a grave danger of the system discharging automatically, and the fire station alarm bell will sound.

The final stage, reached when the first two have been passed through, is the fire warning itself. This is given when air pressure falls below 10 lb/sq in, and indicates the affected area on the map indicator, lights the "fire" panel, and sounds the fire station bell. When a deluge system operates in one of the hangars, all the rolling-steel fire shutters automatically close, leaving only two small shutters for escape purposes.

Areas in the headquarters building where oil fires are likely to occur, are covered by seven "Mulsifyre" systems. If these are triggered-off similar warnings are given as in the case of sprinklers. The final automatic system is a CO_2 installation. At present there is only one of these, situated in the fuel pump shop, and should it go into action similar warnings are given and in addition a bell near the pump shop sounds. Certain warnings, as well as being given on the watch room alarm panel, are also relayed to the headquarters plant room on the top floor.

The system is supplied by two sets of nickel-cadmium accumulators in parallel, which provide a 50 V d.c. supply. A trickle charger is provided, and is fitted with terminals arranged to allow one battery to be withdrawn for servicing without affecting the indicator circuits. Should the 50 V d.c. leads from the charger to the console be disconnected or shorted, the entire alarm system would be put out of action, and to safeguard against this, warning lights have been fitted in the fire alarm panel. Facilities exist for automatically relaying some of the fire alarms to the Ministry of Transport and Civil Aviation's main fire station at London Airport, but this is not being done for the present.

The control and alarm system was designed by Communications Systems, Ltd., and Gent & Co., Ltd.

Television in N.E. Scotland

THE B.B.C. announces that it is intended to open the permanent medium-power television station at Meldrum, 20 miles north-west of Aberdeen, on 12th October. This station will replace the temporary low-power one which has been in operation at Redmoss (Aberdeen) since last December and will use the same frequencies (Channel 4, vision 61·75 Mc/s, sound 58·25 Mc/s). Transmissions from the new station will be horizontally polarized and existing aerials can be used though they may need reorientation.

VIEWS on the NEWS

By REFLECTOR

IN view of the strictures applied to so-called "monopolies" here and the defences which the monopolies have put up to justify their practices it is interesting to read some remarks on the Indian electric lamp industry by Mr. B. K. Rohatgi in the *Indian Electrical Contractor*. After saying that the industry was meeting home demands Mr. Rohatgi said:—

> "In spite of this progress it is unfortunate that within a short time after the resumption of price control for public sale, we had to suspend it this year due to serious internal market competition and accumulation of stock during the early part of the year. If we had only sincerely carried it on for some time more we would have crossed the hurdle. I once again warn my fellow manufacturers that unless we combine together and fight the demon of unfair and unhealthy competition, the industry will be ruined and the country will lose the source of indigenous supply which can only meet the demand of the country in times of emergency."

There has obviously been over-production (or under-consumption) of lamps, for the manufacturers have prevailed upon the Government to restrict production for the third year in succession. In these circumstances it is strange that the Government has imposed a 10 per cent *ad valorem* excise duty on electric lamps.

* * *

Much is being written nowadays about the possibility of establishing satellites and, indeed, one is to be launched into space during the Geophysical Year. But these remote bodies may be preceded by one nearer home—in fact quite near Holyhead. The Clerk of the Urban Council there has been asked to make inquiries into the feasibility of a "man-made moon" for lighting the town. This would be some kind of light attached to a balloon tethered at a height sufficient to provide general illumination which a councillor says is something that the town cannot afford under the present arrangements. Such a device is by no means impossible although I can think of a number of drawbacks. Anyhow, the suggestion is a change from the proposals to use searchlights which crop up at frequent intervals.

* * *

"Good Work Made Men Suspicious" was a recent headline in the *Evening Sentinel* (Hanley). It covered the case of an electrician charged with stealing cable and conduit from Meaford power station. In the evidence it was brought out that two electricians went to check an installation at a certain house to make sure that it conformed to the "necessary standard." They were so impressed with the work that they became suspicious. Apparently it more than conformed with the necessary standard—it was good. This seems to me to be a reflection upon the general character of domestic installation work. The materials were said to be of "a type used in factories." I know that there must be differences between factory and domestic wiring; it is the implication that domestic installations can be "inferior" that I object to. I do not believe that they are as a general rule but the electricians' suspiciousness in this instance raises suspicions.

* * *

My recent reference to the appeal for funds to save the Union Windmill at Cranbrook, Kent, has been seen by Mr. A. Wilson, of Drake & Fletcher, Ltd., Maidstone. My note mentioned that the mill was now normally operated by an electric motor. Mr. Wilson says that his company recently installed an electric friction hoist in the cap of the mill. It proved a tricky business for there was very little headroom because of the mill-head gear and the revolving cap bore into the wind from time to time during operations, which must have been a trifle uncomfortable.

* * *

New vistas are constantly opening up to American electrical manufacturers and dealers many of them of a nature unknown to us. Can we British, for instance, do business with Government departments and officials of a kind reported in the *Electrical World* (New York) in the following terms:—

> "General Services Administration has worked out a plan under which government employees can install air conditioners at their own expense in hot Federal buildings. The Electric Institute of Washington reports that the Government will buy the machines, install, operate and maintain them. But employees will pay for the conditioners, and retain titles to them."

I cannot imagine British civil servants buying, say, electric fires on these terms. But of course they would not be expected to; we are much more considerate of Government employees than the Americans.

* * *

Eighty years ago the *Electrical Review* published a series of articles by Alfred Niaudet-Breguet on "Gramme's Magneto-Electric Machines" which were among the first practical examples of the employment (forty years later) of the principle of electro-magnetic induction discovered by Faraday. The final article, in the issue of 1st October, 1875, discussed likely applications of the machines, particularly the possibility of developing remote sources of power. The author said:—

> "This idea might be of great utility to engineers, who could make use of the motive power of waterfalls so abundant among mountains, and other natural resources, to work the current-producing machine. . . . At the risk of being considered chimerical (*sic*) and dreamers, we maintain that, although unforeseen difficulties may present themselves, this new mechanical combination will probably introduce an industrial and economical revolution throughout commerce, in places where natural forces are available at moderate distances from centres where power is required."

UNIPEDE Congress

Discussions on Reports and Papers

PARTICULARS of the reports and papers presented before the UNIPEDE Congress in London last week were given in our last week's issue. Those covered by the Thermal Generation Study Committee occupied the working session on the Monday which was presided over by Mr. J. D. Peattie (Central Electricity Authority). Discussing the paper on the use of thermal power station ash, Mr. V. A. H. Clements (C.E.A.) referred to efforts being made to supply fly ash ready bagged in relatively small quantities, probably through established merchants of building materials who would retail the ash at a fixed price and possibly under a branded name.

During the past year, he said, the C.E.A. had established an ash marketing branch. To dispose of such large quantities of ash support would be required from all potential users—public authorities, contractors, consulting engineers and architects. A conservative estimate of the ash at present used commercially in Britain was 200,000 tons a year; this would probably be doubled in twelve months. Even such a rapid increase would be insufficient to make an impression on the quantities which would be forthcoming.

The biggest obstacles to the use of fly ash were traditional conservatism, excess of caution and the need for large-scale investment by manufacturers. Progress would at first be slow but with wider recognition of the value of fly ash its use would spread rapidly. British production of fly ash was 4 million tons per annum not 6 million as stated in the paper. Both he and Dr. J. S. Forrest (C.E.A. Research Laboratories) disagreed with the statement that the substitution of fly ash for cement risked deterioration in concrete. All available information indicated that in some respects it would improve the concrete and in no case would it cause deterioration.

Dr. Forrest denied that pulverized coal fly ash was the usual source of germanium in this country. Many analyses of fly ash samples had shown a maximum germanium percentage of 0·01, which was much too low for economic extraction.

In his reply, Mr. Van Antro said there was a danger of insufficient competent supervision in the use of fly ash in concrete on a building site and this had led the Americans to postpone its use for high-stress applications. In a British power station he had seen fly ash properly sacked, like cement, which he believed to be most important.

Coal and Oil Firing

Discussing combined coal-oil fired stations, Mr. A. Mathiassen (Denmark) said that Denmark relied entirely on imported fuel and that low qualities of coal made simultaneous oil firing necessary. This method was preferable to alternating firing, even if fair coals were available. Mr. Louwerens Vos (Holland) held that simultaneous firing was best when coal and oil supplies were satisfactory; otherwise it was best to separate the operations.

Mr. H. V. Pugh (C.E.A.) reported that gas washing was introduced at Bankside station, because the oil contained 3½ per cent of sulphur. The capital cost of that equipment, using the author's table on initial capital expenditure, represented 10·02 per cent.

Commenting on the paper on the starting of boilers and turbo-alternators, Mr. A. Charbonnier (France) said it was more important to carry out starting and stopping operations with safety than to reduce the time required for the operations, but a reduction in this time could lower labour costs.

Mr. G. R. Peterson (generation operation engineer, C.E.A.) presents the report of the Thermal Generation Study Committee. On his left are the session chairman, Mr. J. D. Peattie (deputy chief engineer (generation), C.E.A.) and Mr. L. Chalmey (general secretary of UNIPEDE, Paris)

Mr. J. L. Ashworth (C.E.A.) pointed out that quick-starting techniques applied to the large amount of plant with moderate temperatures and pressures, which was shut down overnight, could yield substantial economies, and Mr. H. V. Pugh emphasized that rapid starting should not be considered as abnormal procedure but as a sound technique associated with two-shift operation.

Power Station Effluents

Mr. F. F. Ross, introducing the paper on power stations and the effluent problem, commented that fish existed before power stations and in the English law courts they were more important than electricity. Nevertheless fishermen were learning that power station effluents did not harm the fish. M. Jean Bossaert (Belgium) described the law in his country on pollution (introduced in 1953) as analogous in some respects to British law.

Dr. H. E. Crossley, introducing the paper on atmospheric pollution, related how toy balloons were released through the chimneys at Little Barford power station, weighted to have the same falling speed as that of the heaviest dust particles emitted. Of five balloons returned, two were from over 100 miles away and two from over 60 miles away. A great need was a trustworthy recording instrument which would measure sulphur dioxide pollution at intervals of only a few minutes. He showed a picture of plumes of washed gas from Battersea power station which indicated that they did not rise after leaving the chimney. Gas washing had to be almost 100 per cent efficient or traces of sulphur dioxide were liable to be brought to the ground very quickly and give worse conditions than if there had been no gas washing.

M. Robert Rath (Electricité de France) was convinced that chimneys 2½ times the height of the buildings did all that was economically possible. Complaints were nevertheless more often sent to the French national electricity

undertaking than to private concerns which polluted the atmosphere much more.

M. Paul Delsemme (Belgium) discussing slag-tap methods of firing, suggested that dry ash firing presented such difficult problems that slag-tap firing would be adopted as a solution. The different kinds of coal used in Belgium involved considerable changes in fusion temperatures. He inquired whether there had been any experience of trying to solve the fusion problem by adding supplementary heat to the furnace at the appropriate time by means of oil burners. On behalf of the author it was stated that the provision of additional heating by oil burners was not in use in Germany. M. Cell Wilwertz (Belgium) said the addition of fusion agents in tests on coal of 32 per cent ash content at fusion temperatures higher than 1,550 deg C had increased clogging.

Pumped Storage

The Central Electricity Authority's first pumped-storage scheme was outlined by Mr. A. R. Cooper (C.E.A.) to the Hydro-Electric Generation Study Committee on Tuesday. Future generating plant programmes would have to take into account the trebling or quadrupling of present levels of output. That increase would have to be carried by thermal generation, whether by conventional or atomic fuel. In either case, the plant units would be inherently inflexible. They would be inappropriate for meeting peak loads and would need night load in order to maintain their load factor.

Normal hydro-electric generation would become less significant with time. Run-of-river stations would carry base loads because they must take the energy as it came. Pumped storage would be increasingly used in association with atomic energy or large-unit steam generation.

The pumped-storage scheme under consideration by the C.E.A. was to have a capacity of 300 MW, possibly in 75 MW vertical units, working on a difference in reservoir levels of 1,000ft.

Replying to Mr. Georges Brondel (O.E.E.C.), who pointed out the desirability of a reversal of the present practice in Switzerland of exporting power in the summer and importing it in the winter, M. Aeschimann said this would not be practicable because some Swiss industries had been established on the basis of water power; run-of-river power, which was relatively cheap, must be available to them all the year round.

In the discussion of Dr. Semenza's paper on underground construction, Mr. Cooper asked whether geophysical surveys had been sufficiently reliable to eliminate some of the boreholes otherwise necessary? The author stated that his experience did not support this hope. For instance, when crossing a valley by a tunnel, the need for certainty of not encountering adverse conditions called for a sufficient number of boreholes.

The Lord Mayor of London (Sir Seymour Howard) and Lord Citrine (president of UNIPEDE and chairman of the C.E.A.) converse with Mr. P. W. Tucker (technical editor, "Electrical Review") and Mrs. Tucker at the civic reception at the Guildhall

Dr. T. Nilsson (Sweden), opening a discussion on dam construction, said that in Sweden earth and rock-fill dams were generally more economical than concrete dams, as construction and maintenance costs were less, and their life longer. In the discussion of the function of steam power stations in association with water power, Mr. T. Hedin revealed that Sweden had just placed an order for a 40 MW gas turbine which he claimed to be the biggest ever ordered.

Mr. Cooper referred to the possibility of noise nuisance from the high-frequency whine of gas turbines. For dealing with peaks or for stand-by service, neither steam nor gas turbines could compare with hydraulic reservoir storage or pumped storage.

Mr. G. Bardon (France) emphasized the growing importance of flexibility. Increasing consumption in Western Europe would entail production mainly by thermal generation, but peaks and troughs would remain and the flexibility of nuclear generation would probably be low. Rising labour and fuel costs, Mr. Cooper said, had a less marked effect on hydro-electric schemes. If a survey showed a hydro-electric scheme to be a profitable investment for the first few years of its life, any change in future conditions almost certainly favoured the hydro plant.

Dr. Claudio Marcello (Italy, chairman of the committee) referred to the approaching exhaustion of water-power resources in some countries, including Italy, and the consequent increasing of thermal competition of conventional or nuclear type. Irrigation and reduction of floods, however, meant that hydro plants still had great possibilities.

Cross-Channel Cable Project

At the International Interconnections Study Committee on Tuesday, Mr. P. J. Squire (C.E.A.) described the British method of simulating automatic control during experiments to evaluate power fluctuations on the projected submarine cable between Britain and France.

The normal running spare in Britain of 500 MW, under the control of the regional centres, was supplemented by special arrangements to have a further 200 MW of running spare in mid-load-factor stations, which were briefed to give a quick response. This additional 200 MW was carried by 800 MW of plant, the loading instructions for which were given from national control by teleprinter to area controls, who passed them to the stations by telephone. A very sensitive frequency recorder was used with a scale giving 5in for 0·1 c/s error.

Despite the delay between the issue of a loading instruction and its receipt by the stations concerned, the control had been easy to operate. For long periods during the day the instructions had to be given only at infrequent intervals and during these periods the frequency was kept well within 0·05 c/s at 50 c/s. Even at times of rapid load change it could be kept within 0·08 c/s. The object was to estimate rate of change of frequency to facilitate this control and it became clear that automatic control would necessitate a rate of change of frequency element.

The British power frequency characteristic was more than double the French and the standard deviation was 0·6 per cent of the load, as against 0·5 in France, where a tighter control was exercised by an automatic system. The British standard of $\pm 0{\cdot}1$ c/s perhaps placed too much stress on frequency control rather than on minimizing any discrepancy between generation and demand. M. Cahen

had visualized an interconnected Western Europe with a load of 35,000 MW and a power frequency characteristic of 7,000 MW per c/s, suggesting that to keep within the frequency limits of ±0·1 c/s we could afford a system error of ±700 MW. Mr. Squire said he looked at it the other way round. If one half of the system were responsible for a frequency error of 0·1 c/s, given equal system characteristics a power transfer of 350 MW would be superimposed on a planned transfer between two halves of the total combined system. It seemed unlikely that we should be satisfied with system errors of this magnitude. It might well be that we should wish to set a higher frequency standard or, alternatively, deliberately to reduce our system power frequency characteristics in order to obtain a better system-control performance. In the latter event that would mean wider frequency fluctuations, although that in itself would not be important.

M. A. Antoine (l'Electricité de France) thanked Lord Citrine and the staff of the C.E.A. for their work on this project and Professor Giovanni Silva (Italy) said that never had such a link been studied with such care as this.

During the discussion, the link between Sweden and Denmark, one of the first European interconnections, was described. The supply in Sweden was mainly by water power and that in Denmark entirely by thermal power; the interconnection had permitted larger thermal units to be installed in Denmark and the export of surplus from Sweden at times of snow melting and summer industrial vacations. Negotiations were proceeding for more extensive co-operation in Scandinavian countries and for a submarine cable between Norway and Denmark.

Transmission and Distribution Questions

Discussing the economic comparison between the transport of coal and the transmission of electricity, Mr. P. W. Cash (C.E.A.) emphasized the importance of the initial coal haul distance, variations in which could influence these comparisons to an extent comparable with that of the variation in interest rates, which was one of the main points brought out in the paper.

In Britain many other factors had to be taken into account. In addition to wide variations in the distances between pit-head and power station in a coalfield area, there were wide variations in the distances between the power station or main transforming station in a receiving area and the load centre to be fed. It was becoming ever more difficult to find sites for new power stations close to the load centres. Cheap transport of coal by sea along our coasts complicated the problem of finding the most economic way of transferring energy from the coal mine to the consumer. We had found it best to study individual cases rather than to attempt to develop a general solution. In Britain, for many hours during the year, a surplus of generating power in the coalfield area was available for transmitting energy to the importing areas. Plans for 1960 envisaged that to meet the demand of the southern part of England, including London, about 90 per cent of the required generating plant would be situated in the southern area and about 10 per cent in the Midlands coalfield area. But because the other plant in the coalfield area would not be fully employed in meeting local demand at off-peak periods, the surplus available could be transmitted to the south to meet nearly 50 per cent of its energy requirements.

Discussing voltage trends at the Distribution Study Committee, Mr. G. O. McLean (South Western Electricity Board) suggested that the word "trend" should be changed to "irregularities" or "variations." Although statutory limits of variations in Britain were ± 6 per cent, variations up to ± 10 per cent had not aroused adverse comment in rural areas, but with the spread of television that might become serious. A recent survey showed that more than 40 per cent of the population in an industrial area owned television sets, and the quality of the service, which depended on the smallness of the voltage variation must be satisfactory. Notwithstanding that, even 15 per cent would be acceptable to rural consumers if they were assured that it would postpone any increase in cost. An ordinary voltmeter, which measured ordinary variations, was quite sufficient guide to the distribution engineer regarding the need for action.

Lord and Lady Citrine receiving Sir Henry and Lady Self

In the Protection of Telecommunications Study Committee, M. Paimboeuf said that danger to equipment had led to the limit of 650 V mentioned in his paper, since that was the breakdown voltage in practice of some underground cables. With high-quality equipment higher limits might be obtained in the near future, which would increase the possibility of co-existence between telephones and power lines.

Structure of Tariffs

Discrimination in tariffs and the apportionment of costs were discussed by the Tariffs Study Committee on Wednesday.

Mr. E. R. Wilkinson (C.E.A.) expressed the view that tariffs would become even more important in the future. When an industry became of such importance that national prosperity was dependent on it, then the prices charged by it became of direct concern to the nation as a whole and it was necessary for the industry not only to do justice between the various consumers supplied but also to demonstrate that justice was being done.

While the tariffs offered to the generality of consumers must be a compromise between the methods which most closely recover the cost of supply and the methods most acceptable to the consumer, there was a new factor in that the charges must be acceptable to the general body of public opinion.

The Report should have dealt more fully with the question of whether marginal cost pricing was right in fundamental principle. It was surely a pre-requisite to its use that public opinion should be informed and convinced of its equity and desirability. The principle of marginal cost pricing had been questioned by a number of responsible economists in recent years and it seemed to have many pitfalls, particularly in inflationary or deflationary currencies. It had been argued that the pursuit of marginal cost pricing to its logical conclusion might be a departure from rather than an approximation to the

goal of maximum human satisfaction, and it had further been argued that the theory was no longer valid in present world conditions, without price flexibility.

The essence of the Committee's discussion was that we could look forward to ever-increasing efficiency and economy. In terms of real cost, the marginal cost of additional output was therefore likely to go on being less than the present average total unit cost, but the industry in its general tariffs could not differentiate between existing and new consumers. It was impracticable to charge at marginal cost so as to bring about that adjustment of output which would equate average cost to marginal cost without incurring losses in the intervening period. Something more than marginal cost had to be charged if the profit and loss account of the industry was to be kept in balance. The difference between marginal cost and average cost has to be allocated between consumers or at least between types of consumers, and there was an increasing need for the industry to determine the principles on which such additional charges should be based.

Discussing the Report of the Working Group on trinomial apportionment of costs, Mr. A. Haselhurst (Yorkshire Electricity Board) pointed out that a mere comparison of costs meant nothing unless they were dealing with two undertakings identical in all respects. The factors to be taken into account in assessing comparative efficiency were so many and various as to make the result of the computations subject to doubt. The system of costing suggested in the paper would, he hoped, be supplemental to the normal allocation for account purposes. They must avoid a cost analysis which was unwieldy, as it could lead to inaccuracy at the initial stage—the workman on the job, whose work should be made as simple as possible. The Committee should avoid presenting undertakings with an allocation of capital costs that was too complicated. Was there a sound engineering reason for treating the maintenance of electrical equipment in a power station as kW related when the maintenance of turbines and boilers was taken as kWh related? Capital charges and the maintenance of connections for low- and high-voltage consumers should be consumer related, because of the great preponderance of domestic consumers, and the necessity to ensure that they pay their full portion of the cost of providing their supply.

Mr. P. Schiller (C.E.A.) agreed that connections to low-voltage consumers and distribution should be allocated to consumers and not to demand. The cost of the low-voltage distribution system represented a major proportion of the total distribution costs and a great deal of harm had been done by allocating these costs to kW instead of partly to consumers, since they were governed mainly by the number of consumers. The allocation of the whole of the distribution charges to demand discriminated against larger consumers.

Scottish All-Electric Flats

An eight-storey block of working-class flats in Kirkcaldy, Scotland, each flat consuming about 10,000 kWh/year, was described by Mr. J. W. Moule (South of Scotland Electricity Board) on Thursday to the Study Committee on the Optimum Utilization of Electrical Energy. There was not a single fireplace or chimney, he said, the occupants being wholly dependent on electricity for all services. Space heating was by cables laid in aluminium housing buried in the concrete floors, which possessed enough thermal storage capacity to enable electricity to be taken only at off-peak periods. Each flat had a 30-gal water storage heater, also an off-peak load.

Each flat had two distinct electricity supplies. The first, unrestricted and charged for at the ordinary variable-block domestic tariff, was connected to the lighting and cooking circuits. The second supply, connected to the floor-warming and water-heating circuits, was cut off by a time switch, between 7 a.m. and 11 a.m. and again between 3 p.m. and 7 p.m.; the charge was a flat rate about 25 per cent lower than the lowest rate (1d/kWh) of the variable-block tariff.

Savings in construction cost due to the elimination of fireplaces and flues more than outweighed the cost of installing the floor heating, while the operating cost was commensurate with that with other fuels. It was hoped to introduce self-contained concrete-block storage heaters to give the same heating effect in existing houses.

The Cooking Load

Mr. W. Gilchrist (Merseyside and North Wales Electricity Board) suggested that optimum utilization must lead to saturation when the whole heat and power requirements of a community were provided electrically. In England and Wales, the present saturation of cooking electrically was 22 per cent, representing some 3¼ million cookers with a peak demand of 1,700 MW; to saturate the cooker load would mean an addition of about 11½ million cookers with a peak demand of 6,000 MW. It might be assumed that this load would grow naturally over some 60 years. Could the process be accelerated to take place in 10 years? It would involve an increase in the national power station and transmission and distribution reinforcement programmes of at least 25 per cent, and with present restrictions on capital and labour that would not be practicable. Moreover, such a single line of development would destroy the shape of the load curve.

No isolated load could be developed to its optimum and then retarded merely because the industry felt that any addition of that type of load would unbalance its economy or necessitate an alteration in the general structure of its tariffs.

Mr. E. A. Fowler (formerly Eastern Electricity Board) who introduced his paper dealing with the commercial organization of the Area Boards, said, in reply to questions, that the £48 million turnover annually meant that the trading activities of the Area Boards were about one-third of the total turnover of domestic appliances in the country, excluding radio and television. Contractors realized that the Boards did not subsidize the sale of appliances from the energy revenue account and that they benefited from the Board's publicity. He told M. Tiberghien (Belgium) that for the Eastern Area, with a turnover of £8 million, there was a staff of 850 associated with sales.

Discussing a report on the utilization of electrical energy in industry, Mr. J. F. Smith (South Wales Electricity Board) suggested that in the absence of other data some of the comparisons made could be misleading. For instance, the energy required to win a ton of coal varied enormously between coalfields and even between pits in the same coalfield. Much more knowledge was needed about the load conditions of individual industries and their effects on the national load curve and about the reasons which induced industrial consumers to take electricity for a new factory. Occasionally there were factors of greater importance than the price of electricity, for instance, absolute cleanliness. Prestige even played a part.

Weather Forecasting

Forecasting the weather and its effect on the load was one of the subjects discussed by the Statistics Study Com-

mittee on Thursday. Mr. G. O. McLean (South-Western Electricity Board) suggested that the Committee had given insufficient attention to effective temperature, for 'it was the reaction of consumers to changing meteorological conditions which mattered. In the south-west of England, where conditions did not fluctuate as much as elsewhere, temperature on three days—the day in question and the two preceding days—was taken into account, whereas national control engineers took only the day in question and the preceding day. The south-west could thus improve the accuracy of the forecasting of their local load by about 1 per cent.

Another parameter which had not received attention was the area covered by the meteorological forecast. The London Electricity Board could be considered as one unit for the forecasting of loads, but what of an area of 5,000 square miles? Was it not necessary to consider each local area separately and then to aggregate the forecasts?

In his own experience a single set of meteorological records would suffice for about 1,000 square miles or a circle of 18 miles radius. If, in addition, that circle contained 70 per cent of the connected load of the whole area, the remainder being a rural area, it was found sufficient—within 2 per cent accuracy—to base the load forecast calculations on that one set of meteorological conditions.

Mr. P. J. Squire (C.E.A.) said the British system of "weather weights" was similar to that described in the report, but he did not agree with M. Vedere that the relation between load and temperature was a straight line. The response of national demand to temperature change was that at about freezing point the slope of the curve was about 150 MW per degree F, whereas at 60 deg F the slope was only about 10 MW.

The effect of wind increased as the temperature decreased, he said. At a given temperature, he had found that the additional demand due to wind was directly proportional to the square root of the wind speed. At freezing point the difference in terms of load between no wind and a 30 knot wind was about 800 MW.

The effect of rain was partly taken into account in the light intensity correction. Although in theory it also increased the rate of heat loss from buildings and should have an effect similar to that of wind, in practice a significant load increase occurred only when there was a heavy downpour which kept people indoors and so increased the demand for electricity, which might amount to 500 MW.

The weather weight system worked accurately for wide fluctuations about a mean load trend, but not when the mean load trend suddenly changed appreciably because of a major change in the prevailing type of weather. When that occurred large errors arose which were in the same direction and were made by each of the grid control areas. This was due to the inability of the human body to adapt itself quickly to changes in climatic conditions.

Swedish Experience

Mr. Olof Berg (Sweden) said that when the temperature was below freezing point in Sweden they could expect an increase in the power consumption, by day, of about 0·6 per cent for each deg C drop, and an increase by night of about 1 per cent. In Stockholm, where cloudiness was an important factor, it was not sufficient to have a temperature forecast; the intensity of daylight must also be stated.

Dealing with the paper on the influence of washing machines on the load, M. Charles Morel (Switzerland) said that Monday was preferred as washday but that in unsatisfactory weather washday was postponed. If the weather did not improve, they then delayed no longer.

Sir John Hacking (Merz & McLellan), Mr. J. Mould (deputy chairman, East Midlands Electricity Board), Mrs. Mould and Lady Hacking

Mr. R. Y. Sanders (C.E.A.), introducing his paper to the Working Group on the investigation of load curves and diversity factors, spoke of the impact of unusual events on the load such as the increases during the British General Election and the Cockell-Marciano fight in America.

Until recently, he said, considerations of time and expense made it possible to pursue the breakdown of load curves into their component parts only by comparatively small samples. Recently statistical methods had opened up new possibilities by the application of multiple regression methods to the successful solution of the problems involved in ascertaining the contribution of particular classes of consumer and particular types of apparatus to the load on an integrated supply system. The methods were still in their infancy, but the advent of electronic computation opened up the prospect, without disproportionate expenditure of time and money, of having regular and up-to-date information about the make-up of system load curves. This would make available to the management of the supply industry a far more effective tool for use in planning and policy than had hitherto been available.

Lord Citrine took the chair at the close of the last working session and congratulated delegates on the success of the Congress. He presided at the closing session of the general assembly, during which it was announced that the next Congress would be in Switzerland in 1958.

The Central Electricity Authority and the Area Boards on Thursday of last week entertained the delegates to the Unipede Congress to a banquet at Grosvenor House, Park Lane.

The toast of the electricity supply industry was proposed by Professor H. C. J. Gelissen of the Netherlands. Replying, Lord Citrine, President of Unipede, said he was very happy that so much had been achieved to provide this country with an efficient supply industry in so short a time. Supply had been given to 3 million more consumers in the last seven and a half years and to more than 5 million more than before the war. He had yet to meet pessimists in the industry—there was everywhere an abounding confidence in the future.

The toast of the guests was proposed by Sir Henry Self and replied to by Signor P. Ferrerio of Italy.

Three study tours in England and two in Scotland were arranged in connection with the Congress, the delegates visiting steam and hydro-electric generating stations, substations, distribution installations and industrial establishments, as well as places of general interest.

Street Lighting Notes

Vertical Fluorescent Lanterns for Edinburgh

THE Minister of Housing and Local Government sanctioned the borrowing of £1,102,228 by local councils for public lighting during the quarter ended 30th June last.

Tests with various types of street lighting which the Edinburgh Lighting and Cleansing Department (engineer and manager, Mr. N. G. Wilson) started a year ago in George Street have now been concluded. Four sections of the street have for some months been simultaneously lit by different lanterns, lamps and ancillary gear made by the General Electric Co., Ltd., and vertical hot cathode fluorescent lanterns have been finally chosen.

Good lighting, economy and a style or lantern in keeping with the street's architecture were the main considerations. Since the fixing of lanterns on the buildings would have involved irregular mounting heights and cellarage under the pavements made the erection of side lighting columns impossible, all the trial lanterns were mounted in pairs on the former tramway poles in the middle of the street.

Three methods of fluorescent lighting were tried. They were vertical lanterns each housing five "Osram" 67½ W cold cathode tubes, from Charlotte Square to Castle Street; "Three-Eighty" lanterns housing three 5ft 80 W hot cathode tubes horizontally, from Castle Street to Frederick Street; and vertical lanterns each housing four 5ft 80 W hot cathode tubes, between Frederick Street and Hanover Street. It is the last section that has been judged the most successful from the lighting, economic and æsthetic aspects. Besides affording comfortable seeing conditions for motorists, the light emitted above the horizontal gives a pleasant overall illumination of the façades of buildings and eliminates "tunnel" effect.

When the vertical lanterns are installed along the whole of George Street, the special brackets on which they were mounted during the trial will be modified, as shown in the accompanying photograph, to meet criticisms on æsthetic grounds.

A modern fluorescent street lighting scheme has been planned for the West End of London, which will be one of the most important of its kind in the country. The WESTMINSTER City Council has selected Revo street lighting equipment for the second stage of this scheme, which includes Piccadilly, Pall Mall, St. James's Street, Aldwych, Cranbourn Street and sections of Knightsbridge, Charing Cross Road, Coventry Street, etc. Both 3-light and 4-light "Sol-Etern" lanterns, using 5ft 80 W fluorescent tubes, will be employed, mounted on lighting columns similar in character to those already supplied by the company for the lighting in Parliament Square. The Revo Street Lighting Erection Department will also undertake the installation of the equipment for the London Electricity Board, who will be responsible for the servicing.

A new £6,450 sodium lighting system in Kew Road, Guildford Road and Carr Lane, Birkdale, SOUTHPORT, was recently inaugurated by Ald. Sir Herbert Barber. This is one of three schemes costing altogether £14,500 which are being carried out by the Southport Corporation Lighting Department, of which Mr. G. W. A. Illingworth is the lighting engineer.

After eight years of continuous pressure by Gloucestershire County Highways Committee, the Ministry of Transport has given approval for the completion of street lighting on the A38 trunk road at FILTON. The need for the completion of such lighting has been stressed by the representatives on the County Council who have urged its importance in view of the particularly heavy traffic on the road. The work was held up because of objections by the Air Ministry.

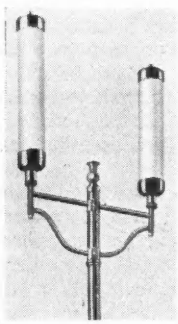
Work is about to commence on SMETHWICK'S third lighting scheme which will cost about £45,000. It provides for 369 Group "A" lamps on traffic routes and 332 Group "B" lamps on other routes. With the completion of this scheme 1,159 new lamps will have been erected on 25 miles of roads in the town. It is hoped to complete the estimated £172,000 programme with three more schemes, of which the average cost will be about £30,000. The completion of the entire programme could be achieved by 1960 but it is stated that future progress will be dependent on permitted capital expenditure.

A new electric lighting scheme in OMAGH, Co. Tyrone, which cost £11,000, was inaugurated recently by the chairman of the Council.

SWINDON Corporation has approved schemes for improved street lighting at Shrivenham Road (£3,150) and part of Faringdon Road (£1,888).

A layout plan for future electric street lighting in AXMINSTER has been approved by the Council. The estimated cost of the scheme is £4,000.

The Ministry of Transport has approved the PENRITH Urban Council's scheme for the erection of 67 new lighting units in the town. Twenty-five of these will be fluorescent lights of 240 W and the other 42 sodium discharge lanterns of 140 W.



George Street, Edinburgh, showing the trial installation of G.E.C. vertical lanterns and (left) the modified bracket to be adopted

CANADIAN POWER FORECAST

The Dominion Bureau of Statistics has issued the first report of a new annual series containing data compiled from returns supplied by 82 major producers of electricity. These account for 98 per cent of the electricity generated for sale in 1953. The purpose of this new survey, carried out in co-operation with the Canadian Electrical Association, is to assess the present power situation and the prospects for the years ahead.

The first survey contains data based on actual plant installations and operating results for each of the years 1950 to 1954, inclusive, and forecasts for 1955 to 1958. During the four years 1950-54 the increase in gross capacity amounted to 4 million kW (43·7 per cent) over 1950 and in the period 1954-58 an expansion of 3·3 million kW (25·1 per cent) over 1954 levels is anticipated. Similarly, during the four years 1950-54 the total demand increased by 2·8 million kW (33·1 per cent) over 1950 and from 1954 to 1958 is expected to rise by 3 million kW (29·6 per cent) over 1954. The total increase in gross capacity from 1950 to 1958 is shown as 7·3 million kW (79·8 per cent) and the increase in total demand over the same period is predicted to be 6·2 million kW (72·5 per cent).

The rate of growth of gross capacity at 9·5 per cent per annum for the period 1950-54 is considerably greater than the 5·8 per cent forecast for the 1954-58 period and the rate of growth in total demand during 1950-54 of 7·4 per cent compares with a forecast for the years 1954-58 of 6·7 per cent.

WORLD ELECTRICAL MARKETS

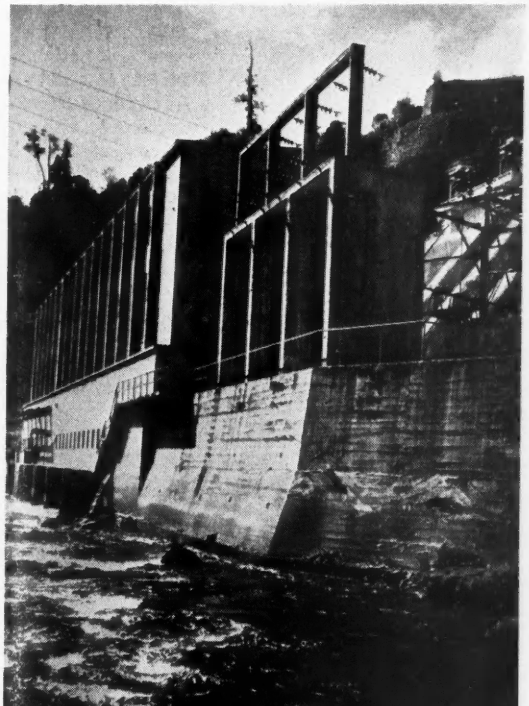
Expansion Plans in Chile

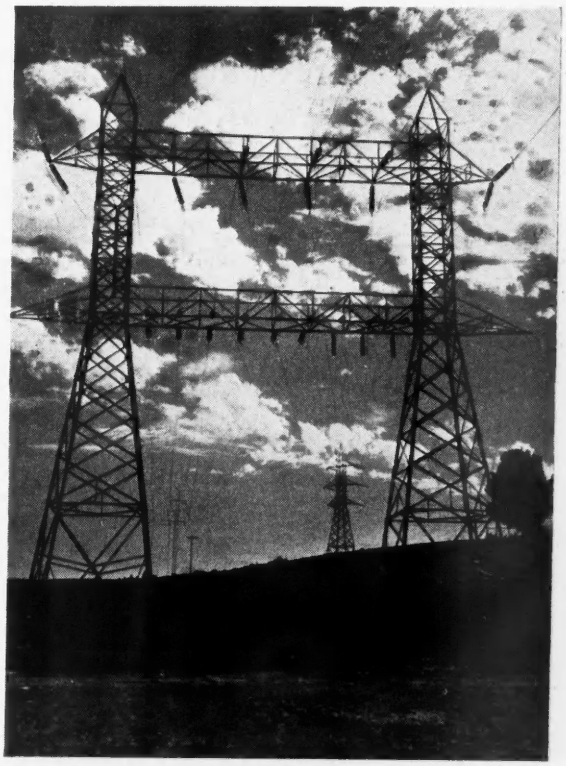
SINCE its constitution in 1939, the Chilean Development Corporation (Corporación de Fomento de la Producción) has given priority to the problem of electrification throughout the country. Before 1939 electricity supply was in the hands of private or joint stock companies distributed throughout the country, principally the Compañía Chilena de Electricidad, Ltda., the Compañía General de Electricidad Industrial and the Compañía Nacional de Fuerza Eléctrica.

What is known as the "General Electrification Plan" was drawn up in 1940 by the Development Corporation and its execution was entrusted to a subsidiary, the Empresa Nacional de Electricidad S.A. (ENDESA) in 1944. The plan is now in its second period (first stage) 1953-1964. For its application the country has been divided into seven geographical zones, viz.:—

First Zone:—This is the northern region and consists of the provinces of Tarapacá, Antofagasta and Atacama. It is a sparsely populated area—375,000 inhabitants or 6·2 per cent of the country's total population (1952 census). The hydro-electric potentialities are poor, there being practically no rainfall except in the Andean heights. At some points, unexploited geothermal energy is to be found, particularly at Tatio and Puchuldiza. In this zone the demand for electric power is estimated to be increasing cumulatively at an average of 7·5 per cent per annum.

Second Zone:—This covers the province of Coquimbo with 255,000 inhabitants—4·4 per cent of the country's total population. Hydro-electric potentialities are limited. the few rivers being of glacial origin and of variable seasonal volume. The cumulative increase in demand for electrical power in this zone is estimated at 9·2 per cent per annum.



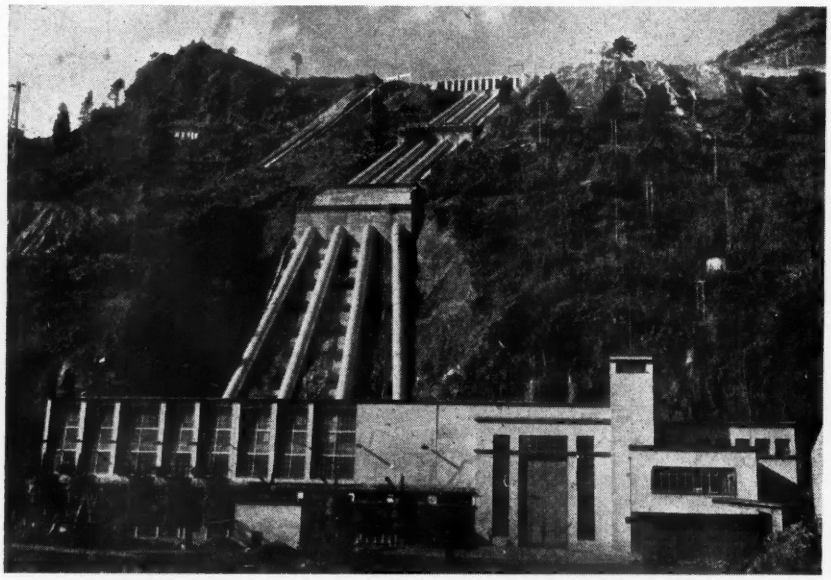


The transmission line from Sauzal to Santiago and (left) hyd ro-electric plant at Pilmaiquen

Third Zone:—This is the most thickly populated area of the country, having 3,191,000 inhabitants—53 per cent of the country's total population—crowded into 10 per cent of its total area. The zone covers the provinces of Aconcagua, Valparaíso, Santiago, O'Higgins, Colchagua, Curicó, Talca and parts of Maule and Linares. In it the hydro-electric potentialities are relatively good although the rivers, of glacial origin, are liable to considerable diminution of flow in the autumn and winter. The cumulative increase in demand in the zone is estimated at 7 per cent per annum.

Fourth Zone:—This includes the provinces of Nuble, Concepción, Arauco, Bio-Bio and Malleco, and parts of Maule and Linares. It has 1,120,000 inhabitants—18·7 per cent of the country's total population. The hydro-electric potentialities are much better than in the zones further north, as the rivers are steadier in volume and reservoirs can be constructed. There are also important coal deposits in the area. The cumulative increase in demand is put at 10·2 per cent per annum.

Fifth Zone:—This covers the provinces of Cautín, Valdivia, Osorno and Llanquihue and has 872,000 inhabitants—15·5 per cent of the country's total population. The hydro-electric potentialities are important,



The Abanico hydro-electric station

because of the almost exclusively pluvial origin of the large rivers and the existence of lakes to steady the flow thereof. Furthermore, there are important coal deposits and abundant timber from the forest regions available as fuel. The cumulative increase in demand is estimated at 9·1 per cent per annum.

Sixth Zone:—This comprises the provinces of Chiloé and Aysén. It has only 133,000 inhabitants—2·2 per cent of Chile's population. It has enormous hydro-electric potentialities owing to the numerous rivers and regulating lakes.

Seventh Zone:—This is the province of Magallanes and is largely uninhabited. It has 55,000 inhabitants—0·9 per cent of the total population. The region has negligible hydro-electric potentialities, but there are extensive deposits of coal and natural gas.

It will be necessary to construct new plants in the Sixth and Seventh Zones as the great distances and very small consumption do not at present warrant interconnection. The hydro-electric potentialities of the Sixth Zone, which are estimated at over 6,000,000 kW (utilizing the Yelcho, Aysén and Baker rivers) would be available for working new electro-chemical and electro-metallurgical industries in the area.

Electrification Schedule

According to the basic details of the plan, the process of electrification is divided into different stages and periods. The first stage covers the development of electrical systems as they existed in 1939 until they are completely interconnected. This first stage is in itself divided into three periods. In the first, recently completed, the development of the different systems within the zones themselves to cover the necessities of each was planned. In the second period, now in execution, expansion of the regional systems will be carried out, to meet the estimated increase in demand, and some of them will be linked up to ensure adequate supplies in the centres of heavier development and demand. In the third period, the interconnection is to be completed and large generating stations are to be erected in the southern lake district, to provide ample electrical energy for all centres.

In 1939 the joint capacity of the private enterprises was 154,600 kW of which 38 per cent was of thermal generation. Between 1940 and 1954 private initiative provided a further 102,700 kW of which 35,700 kW was partly financed by the Development Corporation (the stations at Los Quilos, Puntillas and Los Bajos).

In the same period the contribution of ENDESA was 209,540 kW and it has almost completed a new station which will provide a further 101,400 kW so that during 1955 Chile will have 568,240 kW installed, of which only 19·5 per cent will be thermal.

The new installations so far carried out by ENDESA are hydro-electric stations at Pilmaiquen (Zone 5), 24,240 kW; Abanico (Zone 4), 86,000 kW; Sauzal (Zone 3), 76,800 kW; Cipreses (Zone 3), 101,400 kW; and Los Molles (Zone 2), 16,000 kW. There are also diesel-electric stations at Copiapó (Zone 1), 1,343 kW; Ovalle (Zone 2), 758 kW; Guayacán (Zone 2), 3,680 kW; and Vallenar (Zone 1), 720 kW.

The transmission lines constructed consist of 1,982 km of primary lines at 154, 110 and 66 kV, and 3,043 km of 13·2 kV distributors.

New distributing organizations have been set up at Tocopilla, Copiapó, Vallenar, Ovalle, Colchagua, Pichilemu, Mataquito, San José de la Mariquina-Lanco, Paillaco, de la Frontera, etc., and the existing organizations at Serena, Coquimbo, Melipilla, El Monte, Arauco-Lebu, Valdivia and the Sociedad Austral de Electricidad have been taken over. Power has been made available in extensive outlying country districts and many establishments in the industrial areas. ENDESA now supplies electricity directly to 125 towns and cities and 61 more will shortly be connected to its network. It also contributes heavily towards the requirements of 80 other points within the zones of operation of the independent companies, the Compañía Chilena de Electricidad, Ltda., Compañía General de Electricidad Industrial and the Compañía Nacional de Fuerza Eléctrica, which draw upon ENDESA for a large proportion of the power which they supply.

The work which ENDESA has in hand includes the installation of a fifth generating unit in the Pilmaiquen station and two more sets (Nos. 5 and 6) in the Abanico station and well-advanced preliminary work at Sauzalito, an annexe of the Sauzal station. Work planned for execution in the 1953-1964 period includes, apart from a number of small stations, new plants at Isla (37,000 kW), Rapel (165,000 kW), and Tinoco (53,000 kW), and 40,000 kW extensions at the Laguna Verde plant and two other points near Santiago.

The fifth and sixth units are to be installed at the Abanico station (49,000 kW), and the Lago Laja plant (100,000 kW), and probably a new thermal station (40,000 kW) in the Lota-Coronel district are to be built. In the fifth zone it is proposed to erect a 46,800 kW plant with transmission lines and probably an interconnecting link between the fifth and fourth zones.

The numerous stations owned by independent suppliers

are mostly small but there are some of fairly large capacity including those at Volcán (13,000 kW hydro-electric), Quiltehues (36,000 kW hydro-electric), Maitenes and annexes (26,000 kW hydro-electric), Florida (12,000 kW hydro-electric), Laguna Verde (53,700 kW thermal), Mapocho (20,900 kW thermal), Los Quilos (17,500 kW hydro-electric), Puntilla (11,700 kW hydro-electric), Viña del Mar (12,100 kW thermal), Coya (23,400 kW hydro-electric), Pangal (19,200 kW hydro-electric), and La Ermita (25,000 kW hydro-electric).

By far the most important independent entity outside the Empresa Nacional de Electricidad S.A. is the Compañía Chilena de Electricidad, Ltda., which supplies the Metropolitan and adjacent areas. In 1954 this company supplied 1,130 million kWh to about 274,000 customers; the maximum demand was 233,460 kW.

Limited Manufacture

Apart from a limited production of distribution transformers (up to 2,000 kVA, 15 kV) and power transformers (up to 100 kVA, 23 kV) heavy electrical equipment is not manufactured in Chile. Meters, testers and other precision instruments and equipment have to be imported, but local industry amply supplies the demand for lamps, switches, plugs, wiring, etc. The supply system in Chile is 220 V, 50 c/s.

The Santiago/Valparaíso and Los Andes/Caracoles (Trans-Andean) sectors of the Chilean State Railways are electrified, and there is a project—related to the Agricultural Development Plan—to electrify the line from Santiago to Chillán.

Power at 12 kV for the Santiago/Valparaíso sector is drawn from the Compañía Chilena de Electricidad through substations at Quilicura, Rungue, Llai-llai, San Pedro and Viña del Mar. In each substation are three rotary groups (2,000 kVA each) providing 3,000 V d.c. for the locomotives.

Power for the Los Andes/Caracoles (Trans-Andean) sector (44 kV) is also supplied by the Compañía Chilena de Electricidad through two substations.

All export/import operations are subject to rigorous licensing in Chile, and the licensing mechanism is seriously hampered by shortage of foreign exchange. Unless an importer can arrange for his bankers to open letters of credit out of their own lines of credit abroad payment terms are usually cash against documents in Chile for light equipment.

The imports of the Empresa Nacional de Electricidad for the prosecution of the Electrification Plan have so far been financed largely by loans obtained from the Export-Import Bank and the International Bank for Reconstruction and Development and payment facilities accorded by suppliers. Of a total credit limit of U.S.$26,137,000 in this respect U.S.$24,158,000 had been utilized at 31st December, 1953. The 1953-1964 period of the Electrification Plan envisages expenditure totalling 9,000 million pesos and U.S.$39 million at 1953 prices.

The following are the values of Chile's imports of electrical machinery and material in recent years, the figures being in millions of Chilean gold pesos ($13·59 gold per £1):—1949, 66·67; 1950, 42·00; 1951, 55·55; 1952, 55·23; and 1953, 65·92. The principal suppliers were the United States, the United Kingdom and, latterly, Germany.

The importation into Chile of many classes of electrical material is prohibited.

Municipal Transport

This week (27th to 30th September) the Municipal Passenger Transport Association has been holding its annual conference at Portsmouth. In connection with the conference the Portsmouth City Transport Committee has arranged, through the courtesy of the Walsall Corporation and with the co-operation of the British Electrical Development Association and the British Electrical and Allied Manufacturers' Association, to run the new Walsall trolley-bus on its system. It will continue in service for a further week or two.

This new trolley-bus (the first of fifteen) is of most modern design and is the first of its kind to run in this country; it embodies all the latest technique in luxury passenger vehicles. It has a very large seating capacity (seventy passengers) and is 30ft long on a four-wheel chassis. Previously vehicles of this size have required double wheels in the rear. The chassis has been built by the Sunbeam Trolley-bus Co., Ltd., Wolverhampton. The design has achieved a considerable saving in weight as compared with the older six-wheel type. It has a special lightweight composite body and its power consumption is almost the same as smaller trolley-buses with only fifty-six seats. Maintenance costs will also be less.

The new Walsall 70-seat trolley-bus

Since the beginning of June the Walsall Corporation has opened up a new trolley vehicle route 2¼ miles long and it will shortly add a further route just under 2 miles long. Both routes are to large housing estates being developed by the Corporation, and both represent conversion from motor omnibus to trolley-vehicle operation. Further powers have been obtained to open additional routes serving new housing estates to the north of the town and although the present stage of the scheme gives a properly co-ordinated system both from the operation and vehicle standpoints, the further development can be achieved within this existing framework.

Electrical Housecraft Examinations

Ninety-five candidates qualified for the E.A.W. Certificate at the examinations in electrical housecraft for demonstrators and saleswomen held at various centres in June. The total number of Certificate holders is now 2,312.

At the electrical housecraft examinations for teachers forty-eight candidates qualified for the Certificate, making the total number of holders 2,005.

OVERSEAS ELECTRICAL TRADE

Exports Reach Record Value in August

TOTALLING £19·2 million in value, exports of British electrical equipment last month were probably greater than ever before. The next best figure in recent years was last December's £17·2 million, but both amounts were abnormal in that they included orders held up by dock strikes (and in the case of August, by the recent railway stoppage as well). With the latest returns, the loss sustained in June and July has been made good, the aggregate value of electrical exports for the first eight months of the year, nearly £123 million, being £6·2 million above that for the corresponding period of 1954 (see Table I).

Compared with a year ago, last month's exports rose by £6·8 million. Heavy plant, which was possibly held up more than the lighter types of equipment as a result of the strikes, was exported in substantially greater amounts —generating plant and motors by 48 per cent in value and switchgear, transformers, etc., by 57 per cent. The greatest gain, however, was that recorded for wires and cables, exports of which rose by almost £2 million to £3·1 million. Although India bought more than twice as much as a year ago, the chief increases were under the headings of "other Commonwealth countries" (from

TABLE I.—ELECTRICAL EXPORTS

Class	August, 1955	Eight months ended 31st August, 1954	Eight months ended 31st August, 1955
	£	£	£
Generating sets and generators:			
Diesel-driven, up to 10 kW	155,546	811,527	936,797
Ditto, 10 to 65 kW	77,987	1,290,709	1,036,188
Ditto, 65 to 200 kW	218,488	714,744	928,249
Ditto, over 200 kW	532,550	2,789,521	3,312,251
Spark ignition engine driven	29,143	141,477	156,925
Steam turbine driven	212,394	614,273	1,090,938
Other prime mover driven	8,310	751,232	597,294
Generators	283,854	1,609,070	1,917,433
Parts of generators	710,121	3,239,478	3,551,702
Motors, complete, other than railway, tramway and trolley-bus:			
Up to ½ h.p.	199,300	1,450,603	1,623,747
Over ½ but under 1 h.p.	64,268	396,428	498,541
1 h.p. to 250 h.p.	497,598	3,113,083	2,963,966
Over 250 h.p.	95,762	1,069,091	567,542
Railway, tramway and trolley-bus motors complete and parts of all motors	236,403	1,171,798	1,232,699
Motor starting and controlling gear	246,236	1,584,431	1,537,682
	3,567,960	20,747,465	21,951,954
Converting machinery	40,076	219,430	304,149
Mercury-arc rectifiers	133,973	389,533	581,586
Transformers for lighting, heating and power (incl. coils)	1,278,192	8,098,602	7,041,071
Switchgear and switchboards (not telegraph or telephone)	1,472,543	10,517,192	9,942,572
	2,924,784	19,224,757	17,869,378
Primary batteries:			
Lighting	90,073	543,582	556,174
Radio	191,911	1,166,831	1,359,047
Other	40,331	360,262	296,115
Parts (excl. carbons)	53,170	435,708	263,463
Lamps:			
Filament, exceeding 24 V	111,633	611,797	709,792
Ditto, under 24 V	29,632	239,052	237,837
Discharge lamps, fluorescent tubes, etc.	65,884	478,237	534,370
Other lamps	14,979	190,979	106,311
Radio and television, etc., apparatus:			
Thyratrons, hot cathode mercury vapour and gas-filled rectifiers (excl. mercury arc rectifiers), photo-electric cells, stabilizing and cold cathode valves, magnetrons, klystrons*	13,479	73,465	157,155
Cathode-ray tubes	10,066	—	82,133
Other valves (not X-ray)†	207,657	1,313,694	1,404,509
Radio and television transmitters	55,587	455,988	460,586
Commercial radio and radar equipment	1,179,241	8,137,603	7,928,367
Domestic radio receivers, mains	156,004	1,321,610	1,261,703
Ditto, battery	66,160	458,199	510,725
Ditto, other (incl. car)	12,726	96,479	156,876
Radiograms	36,927	302,735	347,341
Television sets	59,795	189,529	144,283
Public address equipment	77,699	473,758	645,161
Sound reproducing app., n.e.s.	25,810	188,815	190,768
Components and parts, n.e.s., incl. parts of valves and c.r. tubes	654,327	4,489,342	4,818,511
	2,555,478	17,501,217	18,108,118
Telegraph and telephone installations	823,748	4,748,929	5,213,199
Telephone instruments, separately consigned	138,091	880,252	725,866
Telegraph and telephone parts	535,858	3,775,309	3,776,374
Line apparatus for long distance commun.	47,039	1,160,443	581,116
	1,544,736	10,564,933	10,296,555

Class	August, 1955	Eight months ended 31st August, 1954	Eight months ended 31st August, 1955
	£	£	£
Cookers	126,719	603,045	969,679
Toasters	25,535	146,755	246,240
Other cooking apparatus	39,123	270,164	239,526
Parts and accessories	85,256	335,638	550,191
Space heating appliances	24,387	269,538	292,534
Water heating appliances	43,453	204,018	247,719
Other heating appliances	27,940	266,424	218,914
Parts and accessories	68,432	384 784	560,434
Irons	88,285	479,381	798,793
Arc welding equipment, a.c.	38,017	276,858	259,463
Ditto, d.c.	27,969	403,053	227,557
Resistance welding equipment	29,299	139,683	158,435
Electric furnace plant*	141,654	—	417,967
Magnetos, ignition	17,498	118,556	127,227
Sparking plugs	144,493	1,157,806	1,201,315
Elec. appliances for aeroplanes, n.e.s.	182,565	1,475,001	1,484,234
Ditto, for motor vehicles, n.e.s.	289,802	1,889,705	2,384,526
Ditto, for cycles, n.e.s.	70,067	644,435	578,578
Signalling app. (incl. traffic signals)	64,305	445,399	379,609
Industrial radio-frequency equipment	16,033	155,766	113,672
Bell app. (not telegraphic or telephonic)	8,540	65,071	66,659
Instruments, commercial	179,227	1,165,586	1,147,298
House service meters (not prepayment)	119,729	955,844	786,485
Ditto, prepayment and parts of all house service meters	37,439	119,949	190,434
Electro-medical apparatus (not X-ray)	61,078	362,556	376,887
X-ray apparatus (excl. tubes and valves)	59,430	390,634	494,644
Vacuum tubes	15,332	153,412	163,838
Desk fans	40,389	268,970	191,336
Ceiling fans	115,321	777,824	679,173
Parts of fans*	5,461	—	46,095
Vacuum cleaners	83,725	1,407,692	1,045,105
Floor polishers	99,477	845,284	725,410
Food mixers	58,681	382,495	385,097
Hair clippers and dry shavers	92,423	678,786	592,871
Other portable appliances	49,609	211,075	355,500
Parts	67,239	593,399	596,060
Portable elec. tools (not saws) and parts	188,569	1,259,385	1,465,239
Cables and wires:			
Telegraph and telephone, submarine	45,824	592,759	535,817
Ditto, other	731,071	2,705,525	4,077,872
Cotton, silk or art. silk insulated	61,874	299,395	400,319
Enamel, glass or asbestos insulated	83,215	571,706	585,249
Paper insulated	1,277,781	4,269,452	5,571,064
Rubber insulated	535,872	3,215,285	3,748,067
Thermoplastic insulated	141,975	—	657,999
Other	304,751	1,912,333	1,560,726
	3,182,363	13,566,455	17,137,113
Accumulators for motor vehicles	211,560	1,274,136	1,182,226
Ditto, traction	24,401	189,007	133,982
Ditto, radio and other portable	62,570	284,447	466,580
Ditto, other	29,818	437,098	200,069
Parts and accessories	106,081	482,264	726,491
Elec. porcelain, etc. (incl. insulators)	113,143	693,966	726,761
Insulating cloth and tape	70,829	393,910	475,178
Other insulating material	99,766	590,667	734,232
Permanent magnets	36,991	329,318	360,496
Radio, telegraph and telephone testing equipment, n.e.s.	29,774	245,980	327,113
Scientific elec. instruments (not telegraphic or telephonic)	297,497	1,685,992	1,912,890
Electrical machinery, n.e.s.	118,132	990,335	815,636
Electrical apparatus and appliances, n.e.s.	840,383	4,248,302	4,720,598
TOTAL	19,246,380	116,780,668	122,973,283

* Not separately distinguished before 1955.

† The 1954 and 1955 figures are not completely comparable.

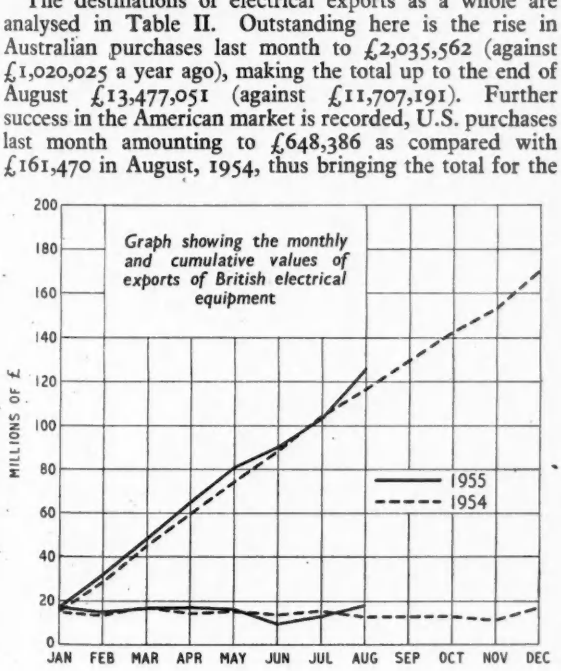
TABLE II.—DISTRIBUTION OF EXPORTS OF ELECTRICAL MACHINERY, APPARATUS AND APPLIANCES

Country	August, 1955	Eight months ended 31st August, 1954	Eight months ended 31st August, 1955
	£	£	£
Channel Islands	66,547	435,382	441,417
Gibraltar	5,872	72,140	139,985
Malta and Gozo	54,662	345,542	366,960
Cyprus	120,897	489,559	749,549
Sierra Leone	18,746	219,395	176,804
Gold Coast	188,569	905,640	1,088,444
Nigeria	299,802	1,223,537	1,989,159
Union of South Africa	1,693,683	12,500,111	11,861,653
Rhodesia and Nyasaland	583,796	2,687,019	3,201,089
Tanganyika	90,944	510,918	616,728
Kenya	358,308	1,164,921	1,339,076
Uganda	135,611	504,560	693,091
Mauritius	27,208	177,741	226,878
Aden	36,769	689,059	335,863
Bahrain, Qatar and Trucial Oman	105,562	983,351	616,104
Kuwait	140,221	1,039,753	725,577
India	1,921,304	10,590,354	10,229,367
Pakistan	410,979	3,814,984	2,686,159
Singapore	444,300	2,170,354	2,527,148
Federation of Malaya	319,688	1,821,057	1,859,940
Ceylon	146,360	994,176	880,887
British North Borneo	20,689	273,114	172,776
Hong Kong	197,551	1,325,045	1,206,870
Australia	2,035,562	11,707,191	13,477,051
New Zealand	943,781	6,604,783	7,954,150
Canada	1,077,395	4,888,465	5,149,941
Jamaica	138,376	514,484	689,067
Barbados	22,473	167,409	143,368
Trinidad	76,374	645,675	687,052
British Guiana	44,137	285,621	376,335
Anglo-Egyptian Sudan	111,126	791,392	645,489
Other Commonwealth countries	150,036	953,656	1,106,330
Irish Republic	374,930	2,181,768	2,620,048
Soviet Union	534,862	1,568,653	1,881,239
Finland	318,071	920,391	1,029,730
Sweden	286,341	2,858,782	2,665,478
Norway	180,955	2,022,524	2,431,952
Iceland	23,234	109,819	92,602
Denmark	121,226	1,387,503	1,152,228
Poland	26,818	529,834	171,487
Western Germany	179,669	983,141	1,258,468
Netherlands	693,184	4,307,877	4,463,450
Belgium	210,194	2,039,190	1,899,529
France	278,520	2,214,697	2,127,747
Switzerland	97,366	721,392	697,134
Portugal	101,484	1,626,539	1,664,196
Spain	75,910	1,937,145	1,051,829
Italy	238,665	1,876,000	1,843,125
Austria	80,560	500,029	420,431
Yugoslavia	138,224	801,725	536,804
Greece	78,917	578,081	738,923
Roumania	735	14,942	1,705
Turkey	128,915	392,353	741,352
Belgian Congo	19,598	237,446	200,564
French Morocco	31,343	190,524	240,989
Portuguese East Africa	20,022	187,662	141,529
Syria	36,537	217,430	229,605
Lebanon	44,081	271,545	258,263
Israel	49,291	261,696	281,643
Jordan	59,903	169,561	247,339
Egypt	185,730	749,783	1,117,580
Libya	44,271	71,487	146,368
Saudi Arabia	44,368	438,425	530,070
Iraq	250,206	1,862,241	1,592,111
Iran	114,097	278,061	512,269
Burma	253,689	1,072,964	1,251,925
Thailand	166,086	1,297,071	1,048,280
Indonesia	24,697	355,293	222,062
Japan	148,007	284,819	698,554
United States of America	648,386	1,975,433	3,329,874
Cuba	40,374	152,831	193,734
Mexico	79,710	222,942	298,387
Colombia	81,530	616,129	640,620
Venezuela	163,429	1,191,272	1,749,584
Peru	99,771	246,853	307,594
Chile	22,201	210,823	215,938
Brazil	95,372	616,605	356,510
Uruguay	18,415	589,284	282,941
Argentine Republic	144,924	651,472	1,211,863
Other foreign countries	204,234	1,292,243	1,817,323
TOTAL	19,246,380	116,780,668	122,973,283

£88,117 to £328,318) and "other foreign countries" (from £103,542 to £732,271).

Among buyers of generating plant and motors, Nigeria, Kenya and Egypt have all taken more than twice as much in the first eight months of this year as in the same period last year, with totals of £423,818, £544,177 and £205,128, respectively. Other large increases are shown for Ireland (£383,882 against £200,329), Turkey (£262,099 against £138,179), Burma (£384,499 against £251,596) and Colombia (£316,577 against £196,657).

The destinations of electrical exports as a whole are analysed in Table II. Outstanding here is the rise in Australian purchases last month to £2,035,562 (against £1,020,025 a year ago), making the total up to the end of August £13,477,051 (against £11,707,191). Further success in the American market is recorded, U.S. purchases last month amounting to £648,386 as compared with £161,470 in August, 1954, thus bringing the total for the year up to £3,329,874 (£1,975,433). Russia also took considerably more last month with £534,862 (against £61,173), as did Rhodesia and Nyasaland £583,796 (£382,701), Kenya £358,308 (£116,968), Uganda £135,611 (£47,262), Egypt £185,730 (£81,378), Turkey £128,915 (£33,160), Cyprus £120,897 (£29,339), Japan £148,007 (£17,609), and a number of other countries.



Besides the equipment included in Table I, several other kinds of electrical exports are listed elsewhere in the Board of Trade returns. Among these are the following, with the August figures and in parentheses those for the corresponding month of last year:—

Electrically-operated washing machines, not exceeding 150 lb weight, £261,798 (£126,424); ditto 150-250 lb weight, £103,012 (£122,679); parts of electrically-operated washing machines, £68,842 (£49,892); electric light fittings and lanterns complete, with or without lamps, but excluding arc lamps, searchlights and cycle lamps, £161,290 (£27,354); other electric lighting appliances, £347,719 (£326,206); electric locomotives, £52,672 (£89,553); and i.c. engine locomotives with electrical transmission, £549,571 (£249,446).

Imports of electrical equipment last month were nearly twice as great as a year ago (£2,210,312 against £1,135,171), making the total for the eight months of this year £15,153,569 (£10,762,635); the principal increases were in purchases of radio apparatus and unspecified goods. The United States was the chief supplier last month with £536,044 (against £285,645), followed by Western Germany with £497,587 (£135,440), the Netherlands with £481,877 (£296,191) and Canada with £166,280 (£88,145).

Preservation of the Countryside

The Council for the Preservation of Rural England is holding a National Conference on the Preservation of the Countryside at Norwich from 6th to 8th October. Particulars are obtainable from the secretary of the Society at 4, Hobart Place, London, S.W.1.

INDUSTRIAL NEWS

I.E.E. Regulations Approvals

The Institution of Electrical Engineers has been informed that the Minister of Fuel and Power has approved for the purposes of the Electricity Supply Regulations, 1937, which now have effect as if made by the Minister under Section 60 of the Electricity Act, 1947, the Thirteenth Edition of the Regulations for the Electrical Equipment of Buildings, with effect from 1st September. Corresponding approval by the Secretary of State for Scotland has also been signified.

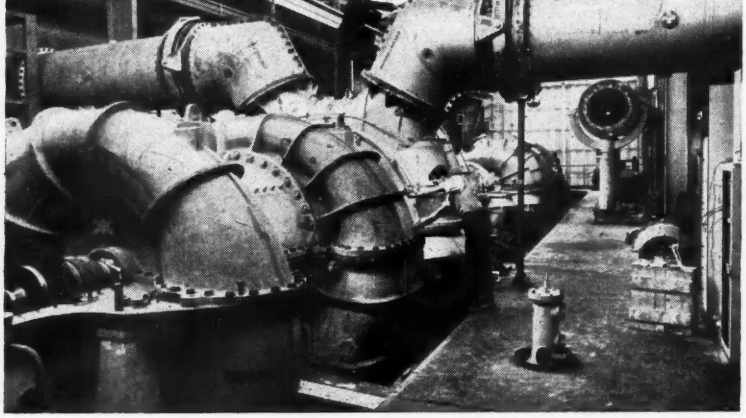
Tendering Arrangements for Copper

The Board of Trade announces that it invites tenders for the sale of about 13,000 tons of electrolytic copper for pricing and delivery over five months beginning in November. The closing date for receiving tenders is 11th October. Applications for tender forms should be made to the Board of Trade (Room 9380), Horse Guards Avenue, London, S.W.1. This quantity is the unsold balance of the 45,000 tons of electrolytic copper the impending sale of which was announced by the Board of Trade on 13th April.

Experimental Gas Turbine Power Station

The accompanying illustration is a constructional view of a new 10,000 kW gas turbine power station at the National Gas Turbine Establishment at Pyestock. The station has been built mainly for studying problems associated with industrial applications of the gas turbine. The plant consists of a two line open cycle gas turbine with inter-coolers and heat exchangers and the electricity generated is consumed in the establishment, which has comprehensive facilities for the testing of various types of gas turbines.

Constructional view of 10,000 kW gas turbine power station at Pyestock



Plant for Scottish Paper Company

The General Electric Co., Ltd., has received an order from the Donside Paper Co., Ltd., Aberdeen, for a 3,000 kW pass-out turbo-alternator set. The direct-coupled machine, running at 3,000 r.p.m., will be provided with a surface condensing plant of Hick Hargreaves manufacture. The closed ventilated alternator will generate at 3,300 V and is designed for operation with a power factor of 0·8.

The consulting engineers for the installation are J. D. Crozier & Partners, Ltd.

Large Turbo-Blower

A new turbo-blower, costing over £750,000, an additional open hearth furnace and ancillary equipment, costing £800,000, and an ingot stocking, handling and loading gantry complete with a 7-ton electric overhead travelling crane, costing £100,000, are to be installed at the Scunthorpe works of the Appleby-Frodingham Steel Co., a branch of the United Steel Co., Ltd.

Foundation work for the new turbo-blower, which will be the fifth unit at the works, has already begun, and completion of the project is expected early in 1957. It will be twice the size of the existing turbo-blowers and will, it is claimed, be the world's largest, the steam turbine generating 20,000 h.p. The blower will be capable of delivering air at 150,000 cu ft/min to the blast furnaces at a pressure of 35 lb/sq in. The effect of the new installation will be to enable greater outputs to be obtained from the company's four blast furnaces.

The consulting engineers for this scheme are the Parolle Electrical Plant Co., Ltd. Foundation work is being done by Holst & Co., Ltd., the structural steelwork being supplied and erected by the United Steel Structural Co., Ltd. C. A. Parsons & Co., Ltd., are supplying the turbo-blower, and John Thompson Water Tube Boilers, Ltd., will provide the boiler.

B.S.I. Birmingham Office

Through the co-operation of the Birmingham Chamber of Commerce, the British Standards Institution has now opened a sales office in the headquarters of the Chamber at 95, New Street, Birmingham, 2. In addition to the sales counter, facilities will be provided for the inspection of British Standards. Normal reference facilities will continue to be available at the Public Library in Birmingham.

Gauge and Tool Makers

The annual general meeting of the Gauge and Tool Makers' Association will be held on 16th November at the Savoy Hotel, London, and will be preceded by an informal luncheon (12.30 for 1 p.m.). During the luncheon the certificates of craftsmanship and certificates of gauge and tool design granted during the past twelve months will be presented by the president and chairman of the Association.

British Radio at the Copenhagen Exhibition

A space of 1,300 sq ft is occupied by the Radio and Electronic Component Manufacturers' Federation at the British Exhibition, Copenhagen, now in progress. Thirty-one manufacturers are exhibiting, 22 having stands and the remainder token displays. The exhibits cover almost the whole range of components for the radio and electronic industries including resistors, capacitors, valves, cathode ray tubes, switches and controls, magnetic materials, microphones, speakers and amplifiers.

Lamp Sales Scheme

In our last issue we gave brief particulars of "Atlas" lamp publicity which has been issued by Thorn Electrical Industries, Ltd., in which we mentioned an incentive scheme. Details of this scheme have now been sent to 35,000 retailers. For four cards from "Atlas" lamp cartons a space atlas can be obtained which includes in full

colour scientific photographs of the moon, the earth from high altitudes, rockets, information about space travel, etc.

Advantages of the Trolley-bus

The September issue of "Public Transport" (a news sheet issued by the British Electrical and Allied Manufacturers' Association) contains illustrated notes on recent additions to the trolley-bus fleets of the Manchester, Huddersfield and Walsall Corporations and gives a list of some of the leading cities of the world in which public transport authorities operate trolley-buses and trams. Mr. T. Bamford, M.I.E.E., A.M.Inst.T., explains why the Doncaster Corporation, of whose transport department he is general manager and engineer, has chosen trolley-buses for its passenger services.

Particulars are given of an essay competition organized by the B.E.A.M.A., the subject being "The Future and the Trolley-bus" and the prize 25 guineas. The essays (between 1,500 and 2,000 words long) should show clearly the operational advantages of the trolley-bus in urban operation and the economic advantages to local councils and ratepayers; and they should indicate the future role of the trolley-bus in improving local transport. Entries should be sent, by 31st December, to Essay Contest, "Public Transport," British Electrical and Allied Manufacturers' Association, 36, Kingsway, London, W.C.2. Each entry should bear a nom-de-plume and have attached to it a sealed envelope inscribed with the nom-de-plume and containing the entrant's name and address.

Gear Manufacturers' Brochure

A well produced and illustrated brochure has been issued by the David Brown Companies entitled "Exempli Gratia," showing how the resources and enterprise of the David Brown Companies have contributed to the development of practically every industry in all parts of the world. After a brief review of the history of the company the activities of the gear, foundry, tractor and automobile groups are outlined.

N.Z. Contracts for Italy

New Zealand Hydro-Electric Department has accepted an Italian steel tender of about £250,000 because it was £160,000 less than the lowest New Zealand tender. The Minister in charge of the Department, Mr. Stanley Goosman, told the House of Representatives recently that the Italian firm also promised delivery in six months; the local company offered delivery in two years. The contract is for steel members for electric transmission line pylons. He said that the Italians had been given a second similar contract for about £100,000 because it was £40,000 less than the next tender. Mr. Goosman was answering a member of the Opposition who had said the Government should take advantage of the availability of pylons in New Zealand from a firm already filling a number of previous contracts. Mr. Goosman said that the price factor was decisive, but the Government also considered the balance of trade. New Zealand could not expect Italy to buy New Zealand goods indefinitely if New Zealand did not reciprocate when Italian prices were favourable. If the Italian tender had not been accepted, the contract would have gone to Britain. He did not indicate what British tenders were received.

Thermal Storage Heaters in Turkey

A school in Turkey is to be equipped with thermal storage heaters developed in Britain by the General Electric Co., Ltd., to enable electricity to be utilized for space heating purposes without affecting the demand for electricity at peak periods. The school is being equipped by George Wimpey & Co., Ltd., in connection with the Hirfanli Dam scheme, where it is necessary to keep the load demand on the temporary generating plant at the minimum. The heaters, however, will still be used when full load is available in about four years' time to help to improve the load factor.

Film Production for Television

A course of lectures on "Film Production for Television," organized by the British Television Society, will commence on 14th October at the Lighting Service Bureau. The course will be opened by the president, Mr. H. S. Hind, A.M.I.E.E., F.R.P.S., and the lectures will include one on "Lighting for Television Films" by Mr. W. R. Stevens, B.Sc., M.I.E.E., F.I.E.S. Further particulars can be obtained from the secretary of the Society, 164, Shaftesbury Avenue, London, W.C.2.

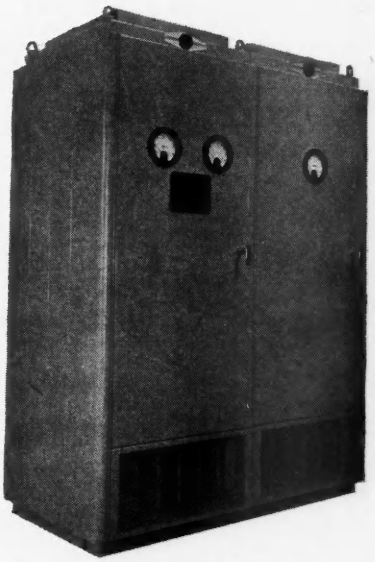
Factory Construction

A new iron foundry just erected for Sterling Metals, Ltd., by Beecham Buildings, Ltd., is an example of the prefabricated members system of the builders. The structural framing and all wall elements, with the exception of the "no-fines" mass walling below window-sill level, are of precast reinforced concrete produced at the Beecham works at Shipston-on-Stour. Buildings erected in this way are claimed to be fully up to the standards of more "conventional" types and the system has many advantages, including speed of erection whatever the weather.

The Sterling foundry consists of a central span of 67ft flanked by two 50ft spans on each side; the height of the buildings is 28ft from floor to eaves level and the total width 267ft. There are also two other spans 34ft wide and 217ft long. Provision is made in the main block for 5 ton cranes. There are a number of ancillary buildings including offices, laboratory, substation, boiler house and compressor house.

First Power Germanium Rectifier

What is claimed to be the first power germanium rectifier to be put into normal commercial service in this country was manufactured by the



B.T.H. 1,000 kW, 255 V, 3,920 A cubicle germanium rectifier equipment

British Thomson-Houston Co., Ltd., to the order of Imperial Chemical Industries, Ltd., and was commissioned recently. The rectifier is rated at 1,000 kW, 255 V, 3,920 A, and it will operate at continuous full load for long periods. It consists of two cubicles housing a series-parallel arrangement of air-cooled germanium rectifier cells connected to form a six-phase, full-wave bridge. The rectifier is supplied from an existing delta/diametric connected transformer which previously supplied a rotary convertor. The B.T.H. Co. is also supplying ten mechanical contact rectifiers, each rated at 3,300/4,050 kW, 220/270 V, 15,000 A, to I.C.I.

Heater Display in Glasgow

With the co-operation of Heatovent Electric, Ltd., of Glasgow, a special display of "Tuvec" patented convector/tubular heaters and "Heatovent" fan heaters, reflector heater and metal and wood-cased convectors is to be held at the Edinburgh Branch, 79/85, Hanover Street, of the Sloan Electrical Co., Ltd., during the week commencing 3rd October.

Cumberland Television Station

The Postmaster-General has approved the construction of a television station in the Caldbeck area to

serve Cumberland, and it is expected that the station will be in operation by the end of 1956. Owing to the topography of the county, the new station will not give satisfactory reception throughout the district, but good reception is expected in the industrial and most densely populated west of the county.

Television in the Channel Islands

The B.B.C. announces that it is intended to start the television service to the Channel Islands on an experimental basis from the new station at Les Platons, Jersey, on 3rd October. Regular test transmissions started on 19th September. The station will operate on Channel 4 (vision 61·75 Mc/s, sound 58·25 Mc/s) and will have an effective radiated power of 1 kW. The transmissions will be horizontally polarized.

Birmingham Electric Club

The annual dinner of the Birmingham Electric Club will be held on 21st October at the Grand Hotel, Birmingham (6.30 for 7 p.m.). Applications for tickets (£3 inclusive of cocktails before dinner and wines during dinner) should be made by this weekend to Mr. J. R. Anderson, hon. social secretary, 76, Somerville Road, Sutton Coldfield.

Experimental Road Heating

The North Riding County Council has installed an electric heating unit experimentally in a section of the A.171 road at Ormesby Bank, North Yorkshire, to try to prevent it freezing in winter. The heating device, installed by the North Eastern Electricity Board, is thermostatically controlled.

Radiator Window Display

The accompanying picture shows a display of Dimplex oil-filled electric radiators installed in the showroom window of Mortimer Gall & Co., Ltd., 115-117, Cannon Street, London, E.C.2. This includes a "Perspex" display radiator which shows the oil filling, element and thermostat, the new Dimplex 1 kW column type radiator, model 100, the new Dimplex 2-dimple high panel type radiator, model B.216 (¾ kW) and model C.412 (1 kW) panel type radiator with detachable chromium plated towel rail.

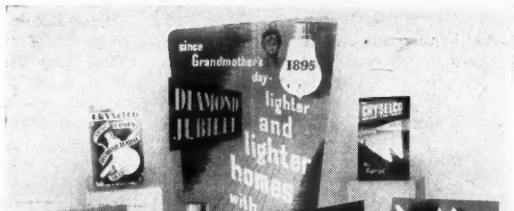
A display of Dimplex oil-filled radiators in the showroom window of Mortimer Gall & Co., Ltd.

Plant for Italian Steelworks

The Fraser & Chalmers Engineering Works of the General Electric Co., Ltd., has received a substantial contract from Ilva Altifoni e Acciaierie d'Italia, Genoa, for a Robins-Messiter ore blending plant to be installed at its Piombino steelworks. The equipment is designed to feed iron ore of two sizes into four blending piles arranged in pairs. This is accomplished by two double-wing travelling stocking trippers at the rate of 400 tons per hour. Each pile has a capacity of 11,900 metric tons. A reclaiming machine spanning the width of the ore bed and consisting essentially of a reciprocating harrow and a plough conveyor, will deliver the blended ore at the rate of 400 tons per hour to main conveyors placed outboard of the piles, for delivery to the furnace plant or alternatively to auxiliary storage. Electric control gear for the equipment will be supplied by the Witton Engineering Works. Ilva is the largest producer of steel in Italy and this plant will be the first of its kind to be operated there.

Technical Education

The London and South Eastern Regional Council of the Federation of British Industries recently discussed, at some length, the question of co-operation between firms and the technical colleges, and has circularized members reminding them of the facilities which may exist in colleges on their very doorstep. While recognizing that many member firms already take full advantage of the facilities offered, the Council believes that on the whole the co-operation between firms and technical colleges is not as close as it might be. It therefore offers certain suggestions on the subject. It emphasizes that nothing can be more effective than personal contact, and for this reason it suggests that managing directors themselves could with advantage take a personal interest in the technical college nearest to their works, and make the acquaintance of the principal. By discussing with him their own particular problems it might well be that the technical colleges would obtain a greater insight into industry's needs. Curricula are sometimes flexible and cases are known where these have been altered to the benefit of the employer, and of course to the trainee. The Council feels that active interest on the part of industrialists in the work of the colleges will lead to a stronger industrial representation on the governing body. Firms might also help by encouraging their senior technical staff to take the opportunity, wherever offered, to serve as members of departmental advisory committees. It is further suggested that much benefit accrued if firms appointed a senior member of their staff to follow the progress of their apprentices by visits and by the receipt of regular reports. A list of the main technical colleges and schools in the London and South Eastern region is issued with the circular.



Examples of lamp publicity material which Cryselco, Ltd., has prepared for the coming lighting season

Trade Announcements

Mr. K. Clark, formerly technical sales representative for North-East England for **Acheson Colloids, Ltd.**, has been transferred to the company's branch office at Richmond. He is responsible for sales development in the Home Counties. Mr. A. D. Wright, B.Sc., has been appointed assistant sales manager of the company, Mr. G. F. Henderson joins Mr. Clark at Richmond as technical sales representative, and Mr. M. C. Lively has been appointed to the London office where he will be responsible for sales development overseas.

S. O. Bowker, Ltd., state that the address of Mr. A. R. Duff, their Scottish representative, is now 73, Robertson Street, Glasgow, where he will have stocks of the company's accessories. His telephone number, Glasgow Central 6962, is unchanged.

The **Hotpoint Electric Appliance Co., Ltd.,** announces a new branch stores and service department at Prospect Mews, Prospect Street, Reading, Berks. The showroom and offices will still be at 72, Oxford Road, Reading.

Engineering in Europe

EXTRACTS FROM FOREIGN TECHNICAL JOURNALS

THE adaptation of line insulators to higher voltages and greater transmitted powers may go different ways, as witnessed by the example of the long-rod insulators evolved and successfully used in two Continental countries, but not adopted anywhere else. A development along more conventional lines is reported by the author, referring to the provision of a well-known insulator type with an annular screen around the ball-head so that the latter is, as it were, placed in a cup. The effect of such a step is not at all obvious at first glance, since it would seem to provide a cistern collecting rain water. However, the fact established by comprehensive laboratory tests is that not only the dry but also the wet flashover and arc voltages of this type are considerably higher than those of unscreened insulators of the same (ball-head) type. It thereby becomes possible to reduce the number of insulators in a string formed of elements of the new type. Compared with anti-fog insulators, the new type is much safer in dry weather and only slightly inferior in rain, where short strings (up to 5 elements) are used. Nine- to twelve-element chains of screened insulators are safer than chains of the same number of anti-fog insulators. It is pointed out that the spacing of elements of the new type should be slightly wider, so that the chain length of a seven-element chain with screened insulators is approximately equal (even slightly longer) than that of a twelve-element chain of normal insulators.—" Cap-Type and Ball-Headed Suspension Insulators with Screened Head and Lengthened Flashover Path," B. Martinoli, *Elettrotecnica*, Vol. 42, No. 4, pp. 220-224, April, 1955, in Italian.

Increasing Transmission Line Capacity

Comprehensive research and operational experience gathered in Soviet transmission systems have shown that the transmitting capacity of lines may be increased by methods rendered possible by the design and construction of the lines, as well as by special installations set up if and when the necessity arises. The first category comprises the use of grouped conductors, reduction of the reactance of transformers and generators, improvement of the exciter system of the generators, accelerated clearance of short circuits; the second category, erection of intermediate sectionalizing or switchover stations, compensation of the line inductance by static capacitors, use of intermediate synchronous condensers as compensators, insertion of resistors and reactors into transformer neutrals, and the use of loading resistances and shunting reactors. Although the installations of the second group are as a rule only added at a later date, the possibility of their erection should be considered during the projecting stage. The obtainable increases of the transmitting capacity are determined for a 400 kV line of 850 km length and 350 MW basic transmitting capacity. The increases obtainable by the combination of various methods are as follows: By use of grouped conductors (3 conductors/phase) increase to 500 MW; grouped conductors and reduction of transformer reactance from 17 to 11 per cent, increase to 650 MW; the same, plus reduction of transient generator reactance from 30 to 20 per cent, 710 MW; previous measures plus longitudinal compensation of 40 per cent of the line reactance, 1,170 MW; use of regulators maintaining generator bus voltage constant, combined with previous measures, 1,500 MW.—" Increase of the Transmitting Capacity of Transmission Lines," D. I. Azarev, *Elektrichestvo*, No. 6, pp. 1-7, 1955, in Russian.

Distribution Protection

Even more than in the protection of transmission systems, the choice of the most suitable protection equipment for distribution systems depends on the system configuration, i.e. whether it is comparatively simple and mainly radial, ring-type or interconnected. Also, the rapid connection of reserves in the case of transformer breakdowns has to be provided for, if possible automatically, a consideration without exact parallel in the case of transmission systems. A good way of obtaining an overall picture of the specific problems involved and typical solutions is that chosen by the author, viz. by describing and discussing the equipment developed and long tried out by one leading firm, with reference to the types of systems in which it may be used with advantage; alternatively, where it has to be replaced by other types.

The three categories of faults to be protected against are interphase and phase-earth faults, and surges. As always, the suitability of certain protection circuits and relay types is closely associated with the particular method of earthing used and the most important cases considered are those of the reactance or resistance-earthed neutral, of the neutral earthed through a resonant (tuned) reactor or transformer and of quenching-coil-earthed neutral. Differential protection of transformers, lightning protection, etc., are also considered and the complete layout of the protections of a typical modern distribution substation is also discussed.—" The Choice of Protection Systems for Low-Voltage Distribution Substations," R. Mascarin, *R.G.E.*, Vol. 64, No. 5, pp. 217-232, May 1955, in French.

Soil Resistivity

The resistivity of the ground is a very important parameter occurring in many calculations concerning the operation of power systems and interference with communication lines, but also important for geophysical investigations, electrical prospecting, etc. From the comparatively numerous methods of determination known, that using the Carson-Pollaczek formula is the most accurate, but applies, strictly speaking, only to a homogeneous ground. For a stratified ground it is necessary to treat the a.c. resistivity as a variable, i.e. a function of the frequency. Also, Pollaczek's method is anything but convenient or rapid. The methods based on d.c. measurements are much simpler, but too inaccurate in the case of stratified grounds.

The author's method is a development of one successfully applied in electrical prospecting and uses vertical soundings carried out with a four-electrode arrangement and d.c. The method is based on the assumption of only

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Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators, who will supply them at current rates.—Editors, *Electrical Review*.

two strata of different resistivity in the ground and it is required to find the apparent resistivity of the ground from measurements of the resistivities of top and bottom strata and of the height of the top stratum. This is possible owing to the fact that the theoretical relation between these four quantities, with the frequency as a parameter, are known and can be conveniently plotted. The apparent resistivity so determined is affected by an error not exceeding 15 per cent which is good enough for practical purposes. —" Determination of the A.C. Resistivity of the Soil," M. I. Mikhailov and L. D. Razumov, *Elektrichestvo,* No. 5, pp. 31-35, 1955, in Russian.

Breaking Capacity of Circuit-Breakers

The difficulties of arriving at an unambiguous definition of the breaking capacity of a circuit-breaker are well known and have been discussed time and again by national as well as international organizations, apart from the huge amount of research work devoted to this problem. Also, the matching of a given breaker to the power system it has to serve requires that the powers on short circuit under the severest conditions at the point of the breaker be known, particularly since the frequencies of the restriking transients are in a certain relation to the power on short circuit.

These and the amplitude factor, i.e. the ratio of the amplitudes of restriking and recovery voltage, are very essential for determining the breaker duties in any given or assumed case. The frequencies of the transient may, in a certain approximation, be calculated from the system parameters; they may also be measured in the system itself (although with some difficulty) and, most conveniently, in network analysers or models (in which the breaker is modelled by a group of thyratrons). This also refers to the amplitude factor. These measurements on the system or its representative model are then compared with the no-load and load characteristics of the breaker, best obtained in a synthetic testing circuit by one of the methods suggested for this purpose, e.g. Rabus's method of saw-tooth characteristics. The author shows that the relation between breaking capacity, amplitude factor and transient frequency may be expressed by a simple approximative formula.—" The Influence of the Frequency of the Restriking Transient and of the Amplitude Factor on the Breaking Capacity," A. Hochrainer, *O.Z.E.,* Vol. 8, No. 6, pp. 185-192, June, 1955, in German.

Sliding Contact Resistances

In a sliding contact the current flows to the " cathodic brush " through numerous minute contact points of the commutator film, which consists mainly of cuprous oxide, and thereby heats the contact points. As a consequence, the resistance of the cuprous oxide varies, which determines the character of the IV curve. In addition, the current has to overcome the diffusion resistance in the brush which also depends on the temperature, though not nearly as much as that of the oxide film. The contribution of the diffusion resistance is particularly marked at heavy loads, but does not alter appreciably the character of the IV curve. The contact area of brush and commutator on which the work of friction is performed is larger than the total area of the contact points, though smaller than the total running surface. For this reason the friction loss does not contribute much to the temperature rise of the contact points. The current to the anode is conducted through the same contact points and, in addition, through larger and more lightly loaded contact areas with a rectifying effect. These act as a barrier towards the cathode. Owing to the lower current density the voltage drop in the oxide film behind the barrier layer and that due to the diffusion resistance in the brush may be neglected. These rectifying areas reduce the contact resistance of the anodic brush.—" The Contact Resistance of Sliding Contacts," F. Schröter, *E.T.Z.(A),* Vol. 76, No. 14, pp. 498-503, 11th July, 1955. in German.

Insulator Discharge Phenomena

The method of gradually increasing the voltage applied to tested insulators, which is the usual one in testing ordinary insulators, is not suitable for investigations of discharge phenomena on insulator surfaces covered with semi-conducting layers, e.g. glazes. For such investigations the only correct method is the sudden application of a voltage pulse. However, care must be taken that no surge is set up on the tested insulator. The author investigates the conditions under which a surge is produced and presents a testing circuit incorporating an electronic switch by which the instant of the application of the pulse can be exactly controlled.

Experimental investigations carried out in this circuit showed that a semi-conducting glaze materially improves the flash-over characteristics of a dirty porcelain surface and that this improvement depends greatly on the ratio of the resistance of unit surface area of the glaze to the resistance of the same area of the dirt layer on the insulator surface. When this ratio decreases, the flash-over voltage and the time lag of surge inception on application of the voltage increase. The improvement was observed whenever the resistance of the glaze was much higher than that of the dirt layers. The experimental results also put it beyond doubt that one of the main factors causing a reduction of the flash-over voltage of dirty insulators is a non-uniformity of the voltage distribution on the insulator surface, this being also as a rule improved by a semi-conducting glaze.—" Effect of a Semi-conducting Glaze on the Discharge Phenomena on a Dirty Porcelain Surface," Den Du Khvan, *Elektrichestvo,* No. 5, pp. 45-49, 1955, in Russian.

Routine Tests of Turn Insulation

Systematic inspection and maintenance of large electric motors, e.g. those driving power station auxiliaries or used in industry, should reveal any weak spots of the turn insulation and enable the corresponding winding sections to be exchanged. These tests should be carried out as impulse tests, which in general require a rather cumbrous equipment and take more time than is mostly available for this special purpose.

The method and apparatus described in the article eliminate these difficulties, since the latter is portable and is placed directly on the slot inspected. It consists of a powerful electro-magnet energized by a thyratron-type impulse generator and inducing a high voltage in the winding section tested. The voltage is regulated by an auto-transformer. If no breakdown of the turn insulation occurs, no current flows in these turns. If, on the other hand, the winding insulation in the slot on which the magnet is placed is punctured and the turns are thereby short-circuited, the e.m.f. induced sets up an impulse current producing another magnetic flux around the short-circuited turns. Part of this flux is closed through the iron of a control electromagnet placed over the slot and an e.m.f. is induced in its winding. The circuit of the latter contains a neon lamp which, however, may be replaced by more accurate indicators, e.g. a microammeter or cathode ray oscilloscope.—" Service Tests of the Turn Insulation of Windings of Electric Motors," M. V. Smirnov, *Elektrichestvo,* No. 5, pp. 49-51, 1955, in Russian.

NEW ELECTRICAL EQUIPMENT

Flush Switch Socket

A new accessory from the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2, consists of a 13 A 3-pin socket beside which is mounted a "Mutac" switch on a Bakelite plate 3¼in square, with holes at 2⅛in centres for fixing directly to a B.S. 1299 or 1363 type box. Each switch socket is supplied complete with a plug fitted with a 13 A fuse as standard; 3 A and 7 A fuses can be fitted against specific requirements. A switch with all the normal "Mutac" features (silver contacts, silent action, and a simple mechanism with only three moving parts, which almost entirely eliminates friction) has been so designed that ample room is provided for wiring when the unit is to be fixed in a B.S. 1299 type box.

G.E.C. shuttered flush switch socket

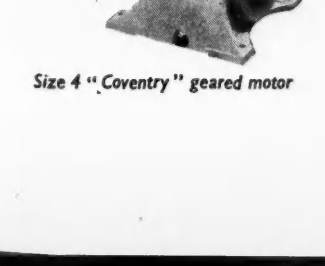
One, two or three 7/·029 conductors can be clamped in the line or neutral terminals. Shutters automatically screen the current-carrying socket tubes; they can only be opened by the insertion of the earthing pin of the plug. Earthing straps are carried to each of the fixing holes to provide automatic earthing when the switch-socket is screwed to an earthed box. An earthing terminal is also provided for systems employing an earth wire.

Catalogue number of the unit is S4954/2959 and the price, finished in brown, is 10s 4d each; finished in cream the price is 11s 4d each.

Geared Motor

A Size 4 "Coventry" geared motor is a new addition to the existing range of sizes, 1⅛, 2¼ and 3 geared motors, manufactured by the COVENTRY GEAR CO. (a David Brown subsidiary), of Foleshill, Coventry. Available in either double or triple reduction form, the Size 4 unit (without motor) weighs 227 lb and 245 lb, respectively.

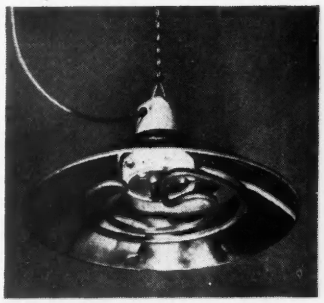
In double reduction form, with a 1,425 r.p.m. motor, any one of fifteen output speeds is available between 105 and 395 r.p.m. The maximum input power ranges accordingly from 7·5 to 15 h.p. In triple reduction form, with a similar motor, the input speed range is sixteen steps from 13 to 95 r.p.m., and the maximum input from 2·5 to 7·5 h.p. In common with the other units in this range, the Size 4 model can be used without motor as a co-axial gear unit.



Size 4 "Coventry" geared motor

Infra-Red Heating Unit

A new dull-emitter type of infra-red heating apparatus has been developed by the BRITISH THOMSON-HOUSTON CO., LTD., Rugby, specially for agricultural use. One unit is adequate for rearing an average litter of piglets from birth to six to eight weeks, or for brooding up to a hundred day-old chicks until they are eight weeks old.



300 W "Pyrobar" dull-emitter for agricultural use

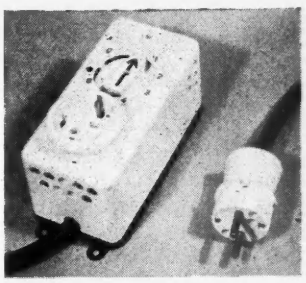
The unit is supplied complete with all fittings ready for installation and connection. It consists of a 300 W "Pyrobar" sheathed wire element fitted to a standard Edison screw cap; an 11in diameter burnished aluminium reflector with a standard e.s. lampholder; 6ft of 3-core heat-resistant cable; and 5ft of suspension chain. The equipment is provided with an earth connection.

The heater and reflector are so formed that an even distribution of heat is ensured over the required area. As the young livestock grow, needing more room and less heat, the simple expedient of shortening the suspension chain enables the heat to be distributed over a larger area at a lower temperature. An important feature of the design is the use of a standard e.s. lampholder in the reflector, allowing the interchange of the heater with a bright-emitter lamp if required.

The heater is guaranteed for twelve months and the price is £3 4s 3d each.

Stabilag "Electrotap"

The "Electrotap" is a new unit operating on the well-known energy regulator principle providing continuous regulation of the power consumption of any electric heating apparatus in a range from zero to about 60 per cent of its full load; it is inserted in series between the mains and the apparatus and can be suspended at any place in the vicinity of an existing wall socket to save the expense of a special wiring installation. The makers are the STABILAG CO., LTD., Mark Road, Hemel Hempstead, Herts.



Stabilag "Electrotap"

The pilot unit, housed in a white plastic case, consists of a heated bimetal strip mounted with three screws on a base plate and should be suspended in the vertical position for satisfactory working. The pilot switching unit is actuated by means of a control knob causing the bimetal strip to change its relative position to the tripping point of the leaf spring, permitting a continuous regulation of the switching cycle.

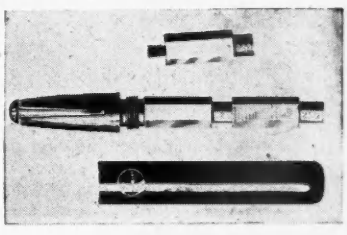
The price of the unit is £5 5s.

Surface Roughness Scales

RUBERT & CO., LTD., of Chapel Street, Manchester, 19, have produced a low-priced surface roughness standard set in pencil type form for clipping in a pocket. The standards consist of specially selected hexagonal stainless steel 1in long, each face being 1¼in wide.

Two sections are available which can be screwed together and fitted into the container as one unit, or supplied as single sections only. Section one consists of 1-2-4-8-16-32 micro-inch C.L.A. to B.S.S. 1134: 1950 designation, and section two consists of 63-125-250-500-1,000 micro-inch C.L.A. to the same designation.

The price of a single section in a container is £4 10s and of a double section in container £8. Single sections can also be purchased without a container for £4.



Rubert pencil type roughness gauge

Financial Section

STOCKS and SHARES

INDUSTRIAL markets of the Stock Exchange are having to contend with something of a glut in new stock and share issues. Congestion here is regarded as one manifestation of the workings of the Treasury's credit squeeze, with its restrictions on bank accommodation, loans, and similar means for the provision of industrial company finance. In these circumstances, the "rights" offer of ordinary shares, at prices below the market, has evidently come to be regarded as the best method available for raising new capital. From the market's point of view, the result is not helpful, for sales of rights (or even the prospect of them) are apt to depress the price of the shares immediately concerned, while the more general effect is to create abnormal competition for the money available for everyday investment.

English Electric Capital

The English Electric Co.'s new ordinary shares, offered to present stockholders in the proportion of one for every three held, began this week at a premium of 1s 9d to 2s on the issue price of 60s. The old shares were called 61s 3d ex-rights. It gives the measure of the recent decline in industrial share prices, and of the depressing effect of a big "rights" issue in these unsettled conditions, to note that the quotation fell about 9s between mid-July and the first intimations of this issue a fortnight or so ago, and a further 12s 6d by the time the allotment letters went out. As previously announced, the company is expecting that this year's profits will cover comfortably a final dividend at the same rate as before on the increased capital.

Simon-Carves Issue

Subscription lists opened yesterday (Thursday) for an offer of 850,000 5s ordinary shares of Simon-Carves, Ltd., at 22s per share. The issue, of which the prospectus appeared last Monday, attracted widespread interest, partly no doubt because of the association of the company's name with that of G.E.C. and other firms in nuclear power developments. Also, this is the public's first opportunity to participate in a business famous in many of the older branches of heavy engineering. Group profits this year are expected to be over the million mark, and for 1956 the directors indicate dividends totalling 22½ per cent. At the issue price, the prospective yield was thus around 5 per cent. Dealings are expected to begin early next week.

Radio Issues

Early dealings in Murphy Radio new 5s ordinary shares took place at a premium of 4s on the price of 13s at which they are offered to existing shareholders, on a three-for-ten basis. In the circular forwarding the allotment letters, the company is satisfied that group trading results for the first

The Week's Price Changes

Company or Board	Nom. Value	Middle price 26th Sept.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	78⅛	+1	3	3	3 16 5	94⅛	76⅛
Brit. Elec. 1974/77	100	76½		3	3	3 18 6	93⅞	75½
Brit. Elec. 1976/79	100	82½	+1	3½	3½	4 4 10	98⅛	80½
Brit. Elec. 1974/79	100	91½	+1	4½	4½	4 14 0	109	90½
Overseas Electric Supply								
Calcutta Elec.	£1	22/-	−6d	6†	6†	5 9 0	22/6	20/9
East African Power	£1	21/-	−1/6	7	7	6 13 4	24/6	19/9
Nigerian Elec.	£1	21/6	−6d	10	10	9 6 0	27/-	22/-
Palestine Elec. "A"	£1	21/-		Nil	Nil	—	22/9	21/-
Perak Hydro-Elec.	£1	21/-	+1/-	6	10	9 10 6	21/6	17/9
Equipment and Manufacturing								
Aberdare Cables	5/-	12/3x.d.		12½	17½	—	14/6	11/-
Aerialite	1/-	6/6		88½	88½	—	6/7	5/3
Allen, W. H.	£1	77/6		20	20	5 3 3	83/9	77/-
Aron Elec. Ord.	£1	60/-	+2/6	15	15	5 0 0	63/9	55/6
Assoc. Elec. Ord.	£1	80/-x.d.	−4/9	11½	14	3 10 0	96/-	62/6
Automatic Tel. & El.	£1	63/9	−1/3	15	15*	4 14 0	79/6	63/9
Babcock & Wilcox	£1	82/6	−2/6	12*	15	3 12 9	98/-	68/6
Baldwin, H. J.	2/-	4/6		20	20	8 17 9	5/6	4/4
Bakelite	10/-	32/6		12½	16	4 18 6	34/6	27/-
British Aluminium	£1	52/-	−1/3	10	12	4 12 6	58/-	35/3
B.I. Callender's	£1	46/-		10	10	4 7 0	55/3	44/9
B.I. Callender's 6% Pref. ...	£1	21/9		6	6	5 10 3	26/6	21/9
British Thermostat	5/-	31/3x.d.		27½	27½	4 8 0	35/-	22/6
British Vac. Cleaner	5/-	7/-	−6d	25	30	—	10/-	7/-
Brook Motors	10/-	44/6	−1/9	20	20*	4 10 0	46/3	39/9
Brush Ord.	5/-	8/3	−3d	6	10	6 1 3	9/6	7/7
Bulgin, A. F.	1/-	7/3		30	45	6 4 3	8/-	4/-
Burco Dean	5/-	13/3	−6d	—	—	—	17/3	13/3
Chloride El. Storage	£1	66/3	−1/3	12½	17½	5 5 3	77/6	58/6
Clarke Chapman	£1	100/-		20	20*	4 0 0	102/6	68/9
Cole, E. K....	5/-	22/3	−6d	27½	17½*	3 18 9	25/6	18/3
Cossor, A. C.	5/-	10/9		10	15	6 19 6	14/-	8/9
Crabtree	10/-	29/-		17½	20	6 18 0	34/6	29/-
Crompton Parkinson Ord. ...	5/-	15/6	−6d	20	20	—	19/9	16/-
De La Rue	5/-	20/-		20	30	7 19 0	26/-	18/9
Decca	4/-	39/6	−1/9	35	56½*	—	48/9	31/-
Desoutter	5/-	33/9		20	25	3 14 0	35/-	25/6
Dewhurst	2/-	10/-		19	24	4 16 0	10/6	7/3
Dictograph Tel.	2/-	8/-	+6d	20	20	5 0 0	9/3	6/6
Dubilier Condenser	1/-	4/3		25	25*	5 17 9	5/7	3/10
E.M.I.	10/-	30/-	+1/3	8	10	3 6 8	37/-	25/3
Electrical Components	5/-	17/-	−1/9	20	25	7 7 0	21/3	15/3
Elec. Construction	£1	32/6		15	8½*	5 4 6	41/3	31/6
Enfield Cable Ord.	£1	20/-	−1/3	Nil	Nil	Nil	25/3	20/-
English Electric	£1	61/3x.r.		10	12½	—	86/9	54/3
English Electric 3½% Pref. ...	£1	14/-		3½	3½	5 7 3	16/9	14/-
Ericsson Tel.	5/-	41/-	−6d	25†	20†*	2 8 9†	46/6	29/-
Ever Ready	5/-	31/-	−1/3	40	35*	5 13 0	38/-	22/3
Falk Stadelmann	£1	42/-		15	15	—	52/6	42/-
G.E.C. Ord.	£1	62/6	−2/6	12½	14	4 9 6	80/3	51/3
G.E.C. 6½% Pref.	£1	23/9		6½	6½	5 9 5	28/4	23/6
General Cables	5/-	15/9	+6d	30	30	9 10 6	17/-	15/-
Greenwood & Batley	£1	52/6		17½	17½	6 13 4	57/6	52/6
Hackbridge Cable	5/-	21/3		20	25	5 17 8	22/6	14/-
Hackbridge & Hewittic	5/-	20/9	−6d	25	30	—	24/9	17/-
Hall Tel. Acc.	10/-	25/-		10	10	4 0 0	25/-	11/-
Heatrae	2/-	5/-		12½	15	6 0 0	5/9	4/3
Henley's	10/-	16/9x.d.		10½	10½	6 5 6	21/3	16/6
Holophane	5/-	16/3		20	25	7 13 9	19/9	16/-

* After scrip issue. † Free of income tax.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

eight months of the year are better than those for the same months of 1954. Murphy are interested, jointly with Pye, in the development of British Relay Wireless & Television, who announce that official consent has been received to the raising of a million new capital.

Hoover Scheme

The Hoover Company's scheme for the simplification of the capital structure received favourable comment all round, although initial reactions in the market showed that some holders of the 1s "A" shares had expected better terms. The price came back from 48s 9d to 46s 6d. As a result of the special rights attached to them, dividends on these shares vary substantially with the level of profits. Under the proposed scheme, the new "A" shares would rank equally with the ordinary for dividends. Its general effect would be to improve the stability, and raise the investment status, of present "A" shareholdings.

in Electrical Investments

Company or Board	Nom. Value	Middle price 26th Sept.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Equipment and Manufacturing—continued.						£ s d		
Hoover	5/-	41/6	−1/6	45	70	8 8 9	52/6	40/-
I.C.I.	£1	49/9	−1/-	15	10*	4 0 6	61/9	38/3
Intl. Combustion	5/-	19/-x.d.		20	25	—	24/6	16/3
Johnson & Phillips	£1	42/-	−1/3	15	15	7 2 10	52/6	41/-
Lancashire Dynamo	£1	50/-	−2/6	14	15	—	56/6	37/3
Laurence, Scott	5/-	18/-		20	12½*	3 9 0	19/6	14/6
Lister, R. A.	£1	31/3	−1/3	12	9·3*	6 0 0	40/-	30/6
London Elec. Wire	£1	52/-		10	12½	4 16 2	61/3	50/6
Lucas, J.	£1	45/-	−1/3	10·8	7½*	3 6 9	56/6	41/6
Marryat & Scott	2/-	12/3		25	30	4 18 0	13/-	9/6
Mather & Platt	£1	65/6		15	13·4*	—	75/-	48/-
Metal Industries	£1	28/-	+3d	9	9	6 8 6	38/-	26/6
Midland Elec. Mfg.	£1	48/9	−1/3	15	10*	4 2 0	55/-	44/-
Morphy-Richards	4/-	28/9		40	35*	4 15 2	35/-	27/-
Murex	£1	60/9	−1/3	15	15	4 18 9	66/-	49/3
Newman Ind.	2/-	2/9		10	10	7 5 6	3/6	2/4
Oldham & Son	1/-	2/9		17½	20	—	3/6	2/1
Parnall (Yate)	5/-	9/-	−6d	8	14	7 15 6	13/2	7/3
Parsons, C. A.	£1	80/-	−6/3	7½	10	2 17 0	100/-	56/-
Plessey	10/-	72/6	−3/-	30	20*	2 15 3	89/-	57/6
Pye Deferred	5/-	22/6x.c.		20	12½*	2 15 6	23/9	14/3
Revo	10/-	13/9		27½	9*	6 11 0	15/6	12/6
Reyrolle	£1	105/-x.d.		13½	15	3 0 0	127/6	89/-
Rheostatic	4/-	12/9		20	22½	—	14/3	9/3
Richardsons Westgarth	5/-	15/-x.r.		15	16¾	5 11 0	19/-	11/-
Scottish Cables	4/-	18/9		27½	27½	5 17 3	22/6	18/9
Smith (England), S.	4/-	16/6		15	17½	4 4 9	20/-	15/-
Southern Areas	£1	32/6		7½	10	6 3 0	38/-	27/6
Strand Elec.	5/-	8/9		17½	15*	8 11 6	13/3	8/6
Sturtevant	5/-	31/3		18·9	14·4†*	2 6 0†	35/9	21/-
Sun. Elec.	£1	35/-		15	15	8 11 6	35/-	33/9
Switchgear & Cowans	5/-	13/9		10	20	7 5 6	17/-	11/-
Taylor Tunnicliff	5/-	13/9		12½	15	5 9 0	16/3	11/3
T.C.C.	10/-	48/9	−2/6	30	25*	5 2 6	53/9	41/-
T.C. & M.	£1	32/6x.d.		8½	8½	5 4 7	40/9	32/-
Telephone Mfg.	5/-	10/6		10	10	4 15 3	11/6	9/3
Thorn Elec.	5/-	22/9	−2/6	20	15*	3 6 0	33/-	13/9
Thornycroft	£1	42/6		15	15	—	47/6	34/6
Tube Investments	£1	92/6	−5/-	15	17½	3 15 8	107/6	72/6
Vactric	5/-	17/6		10	15*	4 5 9	22/-	12/-
Veritys	5/-	12/3		12½	12½	5 2 0	12/3	7/-
Walsall Conduits	4/-	14/6		70	70	—	17/3	12/-
Ward & Goldstone	5/-	35/-	+1/3	50	30*	4 5 9	45/-	32/6
Watford	2/-	8/-		22½	25	—	8/9	6/3
Westinghouse Brake	£1	92/6	−2/9	16	18	3 18 0	110/-	82/-
West, Allen	5/-	13/9		17½	15*	5 9 1	16/6	8/-
Wolf Electric	5/-	21/-	+1/-	17½	20	4 15 3	21/-	16/1
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
A. Ord.	100	69½		6	6	8 12 9	88	67½
Ord.	100	45		3¾	3¾	8 6 8	54¼	45
Anglo-Portuguese	£1	24/6		8	8	6 10 9	27/-	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	21/-	+6d	50	22½*	5 7 3	24/3	19/6
Cable & Wireless:								
Ord.	£1	44/6		9	10	4 10 0	54/-	39/6
4% Loan	100	92½		4	4	4 6 6	100	92
Calcutta Trams	£1	26/3		6†	7½†	5 14 3†	26/3	20/-
Cape Elec. Trams	£1	18/9		5½	7½	8 0 0	19/6	16/6
Marconi Marine	£1	33/9	−1/3	10	10	5 18 6	41/3	33/-
Oriental Tel. Ord.	1/-	75/-		16	—	—	102/6	72/6
Telephone Rentals	5/-	11/6	−3d	10	12½	5 8 9	13/6	9/6

G.E.C. Meeting

G.E.C. shares are affected at the moment by the general unsettlement of electrical engineering issues. At the same time, however, market opinion has been impressed by Sir Harry Railing's review of the position and prospects at the annual meeting. Points to receive special attention included the disclosure that the group's record turnover has been accompanied by a record in orders, the increase in both respects being to a large extent the outcome of the £20 million spent on plant extensions since 1947. Notice was taken also of the chairman's calculation that current wages and hours claims in the engineering industry would have the effect of putting some 8 to 10 per cent on production costs.

Veritys

Veritys 5s ordinary shares seemed to be settling down at around 10s 9d (the official quotation remains at 12s 3d) after a period of fluctuations caused by rumours of an amalgamation and a statement from the chairman in that connection. This said that a proposal has been made to the company, and gave the reasons why the directors are not prepared to submit it to stockholders. The chairman took the opportunity to refer stockholders to his review in the annual report issued last April, when he mentioned that the continued rise in production costs was tending to decrease margins of profit. This position, he said, still persists.

Price Movements

As a group, electrical engineering shares have been tending to sag under the weight of new issues. A.E.I. have been especially dull, falling to less than 80s in the market, despite the expansion reported in the company's half-yearly progress statement. John Thompson, associates of A.E.I. in atomic power production, are maintaining the interim dividend at 10 per cent on capital increased by this year's scrip issue, but the shares were 1s 6d lower at 31s 6d. Richardsons Westgarths were called, in the market, 14s 6d ex rights to the issue of new shares, which had a premium of about 2s on the offered price of 12s 6d. Parsons have been dealt in around £4, and Reyrolles at £5.

REPORTS and DIVIDENDS

The General Electric Co., Ltd.—The need for national productivity to keep pace with any rise in wage costs if we were to compete in the world markets was emphasized by Sir Harry Railing (chairman and joint managing director) at the annual meeting held on 22nd September. He said that the possibilities of progress in the electrical industry all over the world were almost unlimited. The degree to which demand could be satisfied was only conditioned by the availability of capital and the spending capacity of consumers at home and abroad. It was vital for this country to retain its share of the total world exports, especially in electrical goods, in view of the great possibilities in this field. This was the more essential because some traditional United Kingdom exports, such as coal, were likely to contract or might even cease; and we were therefore dependent on maintaining a full share of those in which there was a chance to expand.

The volume of production both for home and export market depended ultimately on our ability to compete not only in quality, but also in price. We had, until about a year ago, generally been able to compete with other countries, at least where there was fair competition. Our ability to compete in price up to 1953 was made possible only because we continued to increase the value and volume of our national product. It was of the utmost importance to maintain this rise in production and at the same time devote the greatest possible proportion of it to export. If national productivity was not increased proportionately to any rise in wage costs we produced inflation with all its attendant evils.

Reviewing the progress of the company during the past year, Sir Harry said that the report showed a gratifying increase in profits in spite of reduced selling margins in many lines caused by wage increases which could not be fully recovered. The good results were due to the increase in turnover and to greater efficiencies arising from plant modernization. During the year negotiations took place for the purchase of the Amalgamated Electric Corporation, Ltd., of Canada. These negotiations had since been completed. The increase in the output of capital goods had been maintained over the whole period and applied to all sections. The increase of consumer goods in some branches, however, was less pronounced in the latter part of the year. The record turnover was accompanied by a record in orders. This again applied to capital goods as well as to consumer goods. The increase both in output and in orders was only possible because of plant extensions planned years ago and put in hand as soon as permission for them could be obtained. It was these expansions, on which they had spent some £20 million since 1947, that had enabled them to increase their strength by 20,000 employees during the last eight years, and thus to extend their activities both at home and abroad to meet the increasing world demand.

Reviewing the company's achievements during the year, Sir Harry said that the new theoretical approach to the problem of interior lighting now enabled them to plan and recommend "designed appearance" lighting schemes without costly experiment. This procedure was proving valuable in all buildings of architectural merit or specific purpose. The technical problems of colour television had been solved to a great extent and the research staff was keeping abreast of current techniques and developments.

In the spheres of fundamental solid physics and semi-conductor development their efforts had been intensified. During the past year they had marketed point contact transistors with a better high-frequency performance than could ever be attained before. Their medium power junction rectifiers had created widespread interest on account of their high efficiency. Sub-miniature transistors had been developed with characteristics which might well revolutionize the telephone industry. New developments had taken place in the telecommunications field.

Speaking on the application of atomic energy for peaceful uses, Sir Harry said that they had a staff of nearly 100 engineers, physicists, metallurgists, chemists and allied technicians in their atomic energy establishment at the Erith works alone, who were devoting their energies exclusively to solving the many problems associated with the production of atomic reactors for research purposes and the design and construction of complete atomic power stations. In this work they were associated with Simon-Carves, Ltd. They had already installed special electric furnace equipment in Government establishments, which was producing the bulk of the metallic uranium in this country required for all nuclear purposes. They had now reached the stage where they were prepared to receive inquiries and to tender for complete atomic power stations of any capacity, and also for special experimental reactors for research purposes. They had already received inquiries from overseas countries for complete atomic power stations and for electric furnace installations for the production of pure uranium.

Some of the more important contracts completed during the year and in hand were referred to by Sir Harry. Among these were four 60,000 kW hydrogen-cooled sets and a 60,000 kW hydro-alternator. They had developed and patented a system of direct cooling of rotor windings which would enable them to build single generating units with outputs in excess of 200,000 kW. Contracts now in hand included direct-cooled 60,000 and 120,000 kW sets. The new heavy turbine shop at the Fraser & Chalmers Engineering Works would enable them to build and test turbines with ratings of up to 400,000 kW. In the steel industry they were the main contractors for the complete power station for the £20 million iron and steel project of Colvilles, Ltd., Motherwell. Work for Government Departments included air compressor plant for the Ministry of Works totalling 350,000 h.p., believed to be the largest installation of its kind in the world.

In the field of transport, new works had been purchased at Dudley Port for the exclusive manufacture of traction motors and generators. Contracts for electrical equipment for rolling stock for the Euston-Watford line and the Liverpool Street-Shenfield-Southend extension totalled well over a million pounds. Plant for the mining industry included a 11,000 V fully automatic skip winder which would shortly be commissioned at Cwm Colliery. This winder represented the latest development of a new system of dynamic braking and automatic speed control.

Production of "Osram" lamps of all types was 30 per cent higher than in the previous year, and would be further expanded by the new factory recently opened at Gateshead. The first street-lighting installation in the world using the new mercury fluorescent lamps with improved colour-rendering had been completed at Blackburn. The outstanding interior lighting scheme of the year was the lighting of the banqueting hall in the City of London's Guildhall.

Sir Harry briefly reviewed the progress of the associated and subsidiary companies, and in paying tribute to the employees mentioned that they now totalled 70,000.

Associated Electrical Industries, Ltd., has issued a progress report for the six months to 30th June last. This shows a trading profit of the group, before taxation, of £6·5 million as compared with £5·48 million for the corresponding period of 1954. The value of output was £58·6 million (£56·9 million) and orders received (mainly for delivery within three years) totalled £67·2 million (£58·4 million). As we have already reported, a second interim dividend of 2½ per cent has been declared.

The report refers to the absorption during the period of Siemens Brothers & Co., Ltd., and the Australian General Electric Pty., Ltd. (now renamed Australian Electrical Industries Pty., Ltd.), and explains that exact comparisons with the profit for the first six months of 1954 are therefore not possible. The figures for 1954 only contain the dividends received from those companies in respect of investments held by A.E.I. during that

period, whereas the whole of their profits are included in the 1955 figures, and this largely accounts for the increase. The figures of output are, however, comparable, as the figures have been adjusted by including both output and orders of these two companies in respect of 1954.

Efco, Ltd.—The annual meeting was held on 22nd September, Mr. D. F. Campbell (chairman) presiding. In his circulated statement, the chairman said that at the end of the last financial year the structure of the company was rearranged and the holding company was now named Efco, Ltd. A new subsidiary had been formed in Basle, Switzerland, and since the end of the year a South African subsidiary, with offices in Johannesburg, had been formed. During the year a part of the Burton premises had been sold and rapid progress was being made towards the completion of new factories at Sheerwater, near Woking, and at Hersham, in Surrey. In addition, premises had been bought at Handsworth, Birmingham, to act as a service depot and warehouse for the distribution of chemicals and spare parts. The order book at the present time was satisfactory in volume, but competition was severe and the continued rise in costs could not be adequately countered by corresponding increases of selling price, especially in the export market. This tendency made it difficult to forecast results in the near future, but the long-term prospects, from a technical point of view, were favourable.

Berry's Electric, Ltd.—The annual meeting was held on 22nd September, Mr. Raymond Berry (chairman) presiding. In the course of his statement, the chairman said that the sale of all their specialized products had increased both at home and abroad. They had continued to give priority to overseas orders and export sales of "Magicoal" fires had increased by 45 per cent. They were selling freely in almost every country of the world where import restrictions did not exist.

Hoover, Ltd.—A scheme for the simplification of rights attaching to the two classes of the equity capital is to be submitted to an extraordinary meeting to be held on 20th October. The proposals involve the capitalization of a total of £420,000 of general reserve in making scrip issues of £380,000 "A" ordinary shares and £40,000 ordinary shares to holders of the existing £80,000 "A" ordinary shares. The effect of the scheme will be that each holding of 100 present "A" 1s ordinary shares will become 115 new "A" 5s ordinary and 10 5s ordinary shares.

The "A" shares will have no voting rights, but they will rank *pari passu* with the ordinary for future dividends, and in a return of assets, will in respect of their new holdings be given a considerably greater participation at an earlier stage than hitherto. It is calculated that on the basis of last year's profits, before tax, the "A" shares on the reconstruction basis would have received £23 12s 10d gross per 100 shares of 1s each by way of dividend against £30 4s 10d they did receive, while the ordinary would get £18 18s 3d per 100 units of 5s each, instead of £17 10s. On the basis of net equity assets as at 31st December last of £10,069,918 the "A" shares on a return of assets would get £64 per 100 shares (against £41 as at present), while the ordinary shares would get £121 per 100 units (against £126).

It is proposed, in view of the already paid 10 per cent interim on the ordinary stock to declare on adoption of the scheme similar interims on the new "A" and additional ordinary capital.

Veritys, Ltd.—Mr. H. B. T. Wilde (chairman) has issued a statement to the effect that the directors have observed with some surprise the number of recent transactions and the rise in the price of the company's stock. They have reason to believe this may be caused by rumours of a possible amalgamation. An approach has been made to the company, which has been carefully considered, but in view of the quite different nature of the business and the finance which the proposal would involve the directors are not prepared to submit any proposal to the stockholders. He considers it his duty to draw stockholders' attention to his statement in April last, that costs of wages, materials and services continued to rise without fully compensating increases in selling prices and, while orders covered production for several months ahead, the margin of profit was tending to decrease. This position still persists.

Aberdare Cables (Holdings), Ltd., has declared an interim dividend of 7½ per cent. This is the same as last year but is on a capital increased early this year by 1,248,950 shares of 5s which were issued to acquire minority holdings in subsidiaries.

Eveready South Africa, Ltd.—The net profit for the year to 30th June last, after depreciation of £8,616 and taxation of £42,663, is £102,295, as compared with £85,373 for 1953-54. The proposed final dividend is 9d per share, making 1s 3d per share for the year (unchanged).

John Thompson, Ltd., has declared an interim ordinary dividend of 10 per cent (same) on capital increased by a 60 per cent scrip issue.

The Ebonite Container Co., Ltd., has applied to the Capital Issues Committee for permission to make a one-for-three scrip issue.

Scottish Cables (South Africa), Ltd., reports a trading profit for the year to 30th June last of £191,824, as compared with £203,271 for the previous year. Taxation requires £50,100 and general reserve receives £25,000. It is proposed to pay a dividend for the year of 14 per cent (against 12½ per cent), and to carry forward £60,508 (against £56,103 brought in).

Bennis Combustion, Ltd.—The group profit for the year to 30th April, after meeting all charges including £31,800 for taxation, is £44,767, as compared with £71,416 for the previous year. The dividend for the year is maintained at 15 per cent by a final payment of 10 per cent.

The Watford Electric & Manufacturing Co., Ltd., has declared an interim dividend of 5 per cent (same) on increased capital.

New Companies

Meter Television, Ltd.—Registered 3rd September. Capital £1,000. Manufacturers, repairers, servicers and hirers out of and dealers in radio, electrical and mechanical apparatus of all kinds, etc. Directors: K. B. G. Taylor (director of Television Assurance, Ltd., and Graham Taylor, Ltd.) and S. Goldsmith. Secretary: Evelyn P. G. Hoath. Regd. office: 7, Stanhope Row, London, W.1.

Whiting Electrical Co., Ltd.—Registered 10th September. Capital £100. Directors: D. F. Cockerill and Mrs. Ivy R. Cockerill. Regd. office: 15, Cromwell Road, S.W.7.

Rodene Electrical Co., Ltd.—Registered 12th September. Capital £1,000. Directors: R. C. Skelton and C. E. Skelton. Regd. office: 579, London Road, Isleworth, Middx.

Liquidations

G. & S. Electrical Services, Ltd.—Winding up voluntarily. Liquidator, Mr. N. W. Osborne, 11-12, Finsbury Square, London, E.C.2, appointed 1st September.

Caton's Metal Production, Ltd., electric fire manufacturers and general metal workers.—Liquidator, Mr. R. K. Clark, 37, Temple Street, Birmingham, 2, released 12th September.

Bankruptcies

S. Whitton and **L. Whitton**, carrying on business in partnership at Church Place, Victoria Road, Leeds, under the style of F. Whitton & Sons, electrical engineers.—First and final dividend of 1s 6½d in the £, payable at 3, Alfred Street, Leeds, 1.

L. Whitton (separate estate).—First and final dividend of 2¾d in the £, payable at 3, Alfred Street, Leeds, 1.

S. Whitton (separate estate).—First and final dividend of 8¼d in the £, payable at 3, Alfred Street, Leeds, 1.

E. Newland, 130, Grove Road, Chadwell Heath, Romford, Essex, electrical contractor.—Receiving order made 14th September on a creditor's petition.

W. E. Crees, electrical engineer, 171, Lavender Hill, Battersea, London.—Receiving order made 15th September on a creditor's petition.

GENERATION AND DEVELOPMENT

Higher Charges in London

To meet the recent heavy increase in the price of coal and additions to its working costs the London Electricity Board announces that it will be necessary to raise charges to consumers to produce approximately £2¼ million in a full year. Industrial consumers whose charges are directly related to the cost of coal automatically pay extra, and charges to domestic, commercial and small power users are to be increased as from 1st October. The "unit" charge of all two-part and similar tariffs will be raised by 0·1d/kWh; the flat rates for lighting by ½d and for heating by ¼d/kWh and the rates for small power, commercial cooking and water heating by 0·125d/kWh. A small increase will be made in the scale of charges for supplies for public lighting. Some 1,670,000 consumers will be affected by the tariff revisions.

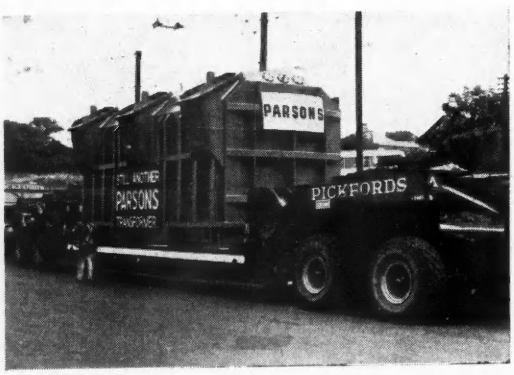
Standard Domestic Tariffs

The London Electricity Board also announces that, from 1st April, 1956, a standard domestic tariff will be introduced, and this will eliminate the remaining differences in domestic tariffs in London. The new standard tariff will result in some consumers paying more and others less, but will not make any material variation in the Board's revenue.

Transformers for Stella West

The accompanying picture shows a 300 kV class transformer in transit from the works of C. A. Parsons & Co., Ltd., for the Stella West switching station of the Central Electricity Authority. This is one of seven transformers ordered by the Authority from the company.

Parsons 300 kV transformer for Stella West switching station



C.E.A. Contracts

Contracts have been placed by the Central Electricity Authority during the past month for power stations amounting in the aggregate to £5,943,000. The principal contracts include the following:—

Goldington power station, Bedford: Cooling tower.—Film Cooling Towers (1925).

Little Barford "B," near St. Neots: Structural steelwork.—Dawnays.

South Denes: Structural steelwork.—Dawnays.

Willington "A," near Derby: L.p. pipework and valves.—Aiton & Co.

Rogerstone, Mon.: Two reinforced concrete cooling towers.—Film Cooling Towers (1925). Ash and dust handling plant.—Babcock & Wilcox. Chimney.—J. L. Keir & Co.

Elland, Yorks: Two 550,000 lb/hr boilers.—John Brown Land Boilers.

Ferrybridge "B," Yorks: 760,000 lb/hr reheat boiler.—Babcock & Wilcox. Cooling tower.—Davenport Engineering Co. Reinforced concrete chimney.—Tileman & Co.

Agecroft "B," Salford: Foundations.—M. J. Gleeson (Contractors).

Italy-Sicily Link

The Rome correspondent of *The Times* reports that the work of passing overhead cables across the Strait of Messina to carry electricity from the mainland to Sicily has been completed, and the company which has been carrying out the work has notified the authorities that there is now no objection to the full reopening of the strait to shipping, which has had to observe certain restrictions since the erection of the cables began on 21st July.

New Power Station at Cork

The Marina power station, the seventh of the Eire Electricity Supply Board's new power stations since the end of the war, was formally opened on 22nd September, at Cork, by Mr. P. J. Crotty, Parliamentary Secretary to the Ministry of Industry and Commerce. From the preliminary development of the station, two 30,000 kW steam turbo-alternators will give an output of 240 million kWh a year, with an annual fuel consumption of 120,000 tons of coal, or 70,000 tons of oil. The three boilers used in the station are the largest ever to be installed in Ireland, and they are the first of their type to be used for the generation of electricity.

Mr. R. F. Browne, chairman of the E.S.B., said that further hydro-electric development was limited because about 70 per cent of the potential power in the country had been harnessed, or was in process of harnessing. With the present rate of growth they would be forced within the next ten to fifteen years to look further afield for means of generation. He announced that the Board would issue, within the next fortnight, its first public loan and he expressed confidence that it would be successful. The rate of interest, he said, would be realistic and an active market would be maintained for the stock. The loan would be State-guaranteed, both in respect of interest and capital.

St. Lawrence Seaway

Shipping will move through the St. Lawrence Seaway in July, 1958, several months ahead of the schedule laid down when the project was undertaken a year ago. The Ontario Hydro-Electric Power Commission also expects to take its first electricity from the St. Lawrence power development in the same month. This was stated when officers of the U.S. Army Corps of Engineers and the U.S. St. Lawrence Seaway Development Corporation visited Toronto. They discussed with Dr. Otto Holden, the Ontario Commission's chief engineer for the St. Lawrence, the plans which now call for closing navigation for as short a time as possible, while gates in the power-house and Long Sault dam are closed and the water backed up to form the power pool. When this is completed shipping will be routed through the seaway channel and locks —two on the U.S. side of the river opposite Cornwall and the third on the Canadian side at Iroquois.

Original plans called for the watering to take place in December, 1958, at the end of the navigation season. But with the accelerated schedule the engineers are working on methods of watering which will reduce interruption of navigation to as little as 36 hours.

Southern Electricity Council

At a meeting of the Southern Electricity Consultative Council at Southsea on 20th September, with Group Captain J. C. M. Hay in the chair, consideration was again given to the question of Government assistance to the more remote rural communities in respect of the somewhat heavy capital contributions required in connection with the schemes of supply. It was decided to discuss the matter further after publication of the Herbert Committee's report.

The Council also considered whether the separation of generation from distribution brought about by the organization of the industry set up by the Electricity Act, 1947, was in the best interests of consumers. Here again it was decided to await publication of the Herbert report.

Drakelow Power Station

Mr. J. Eccles, deputy chairman of the Central Electricity Authority, will perform the official opening ceremony at the new Drakelow power station, Burton-on-Trent, on 21st October.

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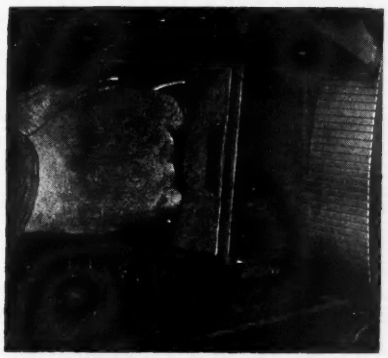

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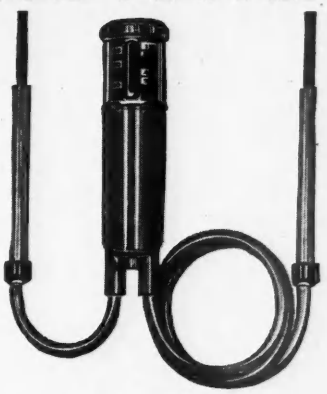

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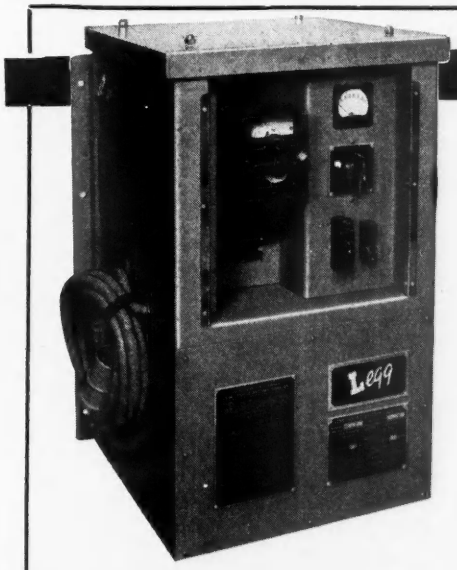

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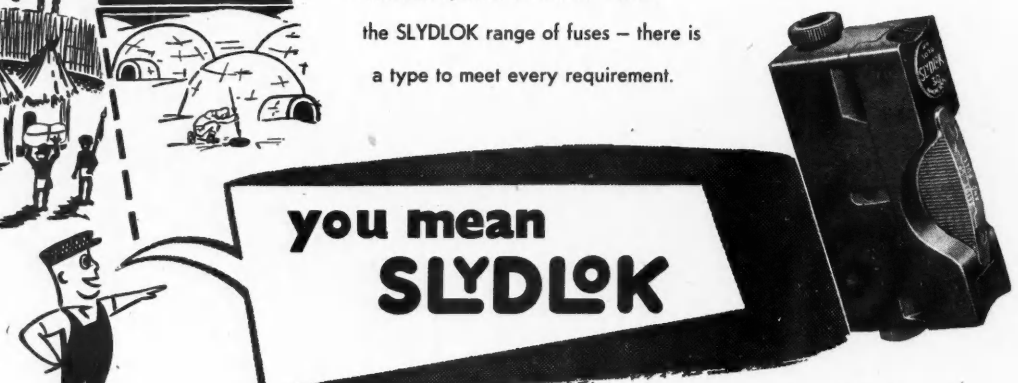

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NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 2nd November from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1949

22273. British Broadcasting Corporation, Mayo, C. G., and Beadle, D. G.—Variable reactance devices and variable frequency electric oscillation generators. 28th August, 1950. (739481.)

1952

1499. Standard Telephones & Cables, Ltd.—Compensated phototube amplifier. 18th January, 1952. (739707.)

7996. Southern United Telephone Cables, Ltd.—Means for recording the readings of an instrument, or group of instruments, suitable for the testing of the circuits of electric communication cables. 27th March, 1953. Addition to 693369. (739710).

13147. Automatically obtaining and recording the readings of an instrument, or group of instruments, suitable for the testing of the circuits of electric communication cables. 22nd May, 1953. (739712.)

9271. Sylvania Electric Products, Inc.—Luminescent materials. 10th April, 1952. (739903.)

13216. Automatic Telephone & Electric Co., Ltd.—Telecommunication systems. 11th May, 1953. (739905.)

16754. Fries, G., and Vredenburg-Inglesby, J. C.—Recording and reproduction of sound and other signals. 2nd July, 1953. (739809.)

19728. National Research Development Corporation.—Ultra-high-frequency devices. 2nd October, 1953. (739716.)

29327. National Research Development Corporation.—Metal-to-glass seals. 15th February, 1954. (739721.)

29371. Hooker Electrochemical Co.—Electrolysis process and apparatus. 20th November, 1952. (739722.)

29550. United Kingdom Atomic Energy Authority.—Charged particle accelerators. 23rd November, 1953. (739909.)

30117. Truvox, Ltd.—Magnetic recording apparatus. 29th October, 1953. (739724.)

30360. Minister of Supply.—Flexible electro-magnetic waveguides. 27th November, 1953. (739488.)

1953

1368. Babcock & Wilcox, Ltd.—Tubulous vapour generating and vapour heating units and a method of operating such units. 14th January, 1954. (739489.)

4857. Yardney International Corporation.—Secondary electric batteries. 16th February, 1954. (739813.)

13195. Standard Telephones & Cables, Ltd.—Facsimile transmission circuit arrangements. 18th January, 1952. Divided out of 739707. (739730.)

18164. Hoover, Ltd.—Face commutators. 24th June, 1954. Addition to 738823. (739914.)

18221. National Research Development Corporation.—Cathode-ray tubes. 1st July, 1953. (739496.)

18363. British Thomson-Houston Co., Ltd.—Current transformers. 25th June, 1954. (739497.)

19649. General Electric Co.—X-ray tubes. 15th July, 1953. (739607.)

19726. Light Actuated Signal & Switchgear Co., Ltd.—Electric control circuits. 16th July, 1953. (739915.)

22624. Siemens-Schuckertwerke Akt.-Ges.—Arc quenching chambers for electric switches. 17th August, 1953. (739735.)

25001. Tornado Akt.-Ges.—Hand guidable domestic suction cleaners. 9th September, 1953. (739737.)

32644. Sperry Corporation.—High frequency vacuum seals. 24th November, 1953. (739745.)

1954

265. English Electric Co., Ltd.—Automatic voltage control systems. 5th January, 1954. (739506.)

394. Compagnie Générale d'Electricité.—Plate separators for electric accumulators. 6th January, 1954. (739613.)

493. General Electric Co.—Electronic discharge tube band-pass filter circuits. 7th January, 1954. (739507.)

1455. Philips Electrical Industries, Ltd.—Supports for electrode systems of electric discharge tubes. 18th January, 1954. (739920.)

1854. Soc. d'Electronique et d'Automatisme.—Clock-pulse generating devices. 21st January, 1954. (739756.)

1967. Philips Electrical Industries, Ltd.—Ground lights particularly for defining airport runways. 22nd January, 1954. (739757.)

2041. Federal Electric Products Co.—Automatic electric circuit-breakers. 22nd January, 1954. (739620.)

2196. Inventa Akt.-Ges. für Forschung und Patentverwertung.—Electrical impact fuses. 25th January, 1954. (739924.)

2240. Allis-Chalmers Manufacturing Co.—Draw-out type electric switchgear. 25th January, 1954. (739758.)

2346. Philips Electrical Industries, Ltd.—Electric contact plugs comprising a resilient envelope. 26th January, 1954. (739759.)

2919. Philips Electrical Industries, Ltd.—Transistor amplifiers. 1st February, 1954. (739510.)

3528. Naamlooze Vennootschap Maatschappij voor Metaalbewerking Industria.—Electric plug and socket connectors. 5th February, 1954. (739514.)

3605. Research Corporation. — Electrostatic precipitator apparatus. 8th February, 1954. (739628.)

3688. Sylvania Electric Products, Inc.—Printed circuit unit assembly. 8th February, 1954. (739828.)

3744. Allmanna Svenska Elektriska Aktiebolaget.—Regulators for synchronous electric machines. 9th February, 1954. (739630.)

3841. Murphy Radio, Ltd.—Radio navigation systems. 9th February, 1954. (739422.)

3863. Philips Electrical Industries, Ltd.—Piezo-electric elements. 9th February, 1954. (739632.)

3908. Kolster-Brandes, Ltd.—Semi-conductor amplifiers. 10th February, 1954. (739829.)

4898. Westinghouse Electric International Co.—Arrangements for preventing inductive interference in communication lines adjacent to a single-phase railway feeder. 19th February, 1954. (739642.)

4899. Westinghouse Electric International Co.—Electromagnetic regulators. 19th February, 1954. (739442.)

4963. Standard Telephones & Cables, Ltd.—Insulated electric conductor and method of fabricating same. 19th February, 1954. (739444.)

5133. Philips Electrical Industries, Ltd.—Electric amplifier circuits. 22nd February, 1954. (739449.)

5287. Standard Telephones & Cables, Ltd.—Inductors. 23rd February, 1954. (739942.)

5296. Philips Electrical Industries, Ltd.—Dispenser cathodes and methods of manufacturing such cathodes. 23rd February, 1954. (739645.)

5486. Sangamo Weston, Ltd.—Dynamometer type instruments. 24th February, 1954. (739947.)

5587. Automatic Electric Laboratories, Inc.—Rotary finder and rotary secondary switch link. 25th February, 1954. (739951.)

5910. Concordia Electric Safety Lamp Co., Ltd., and Steadman, C. H.—Electric circuits for electric-discharge lamps. 1st March, 1954. (739457.)

6163. Telefunken Ges., formerly Telefunken Ges. für Drahtlose Telegraphie.—Distributed line amplifiers. 2nd March, 1954. (739954.)

6194. Arrow Electric Switches, Ltd.—Thermally responsive electric switches. 3rd March, 1954. (739653.)

6453. Allmanna Svenska Elektriska Aktiebolaget.—Control system for three-phase electric motors. 5th March, 1954. (739841.)

6939. Allmanna Svenska Elektriska Aktiebolaget.—Multiple spark-gaps for lightning arrestors. 10th March, 1954. (739658.)

7434. Garnerot & Co. (Consolidated Agencies), Ltd.—Electrical plug connectors. 15th March, 1954. (739472.)

7635. General Electric Co.—Electric protective devices. 16th March, 1954. (739476.)

7900. Philips Electrical Industries, Ltd.—Inductors comprising a permanently premagnetized magnet core. 18th March, 1954. (739515.)

7929. General Electric Co.—Electric circuit arrangements for rectifiers of the mechanical contact type. 18th March, 1954. (739516.)

8112. Standard Telephones & Cables, Ltd.—Coaxial conductor electric cables. 19th March, 1954. (739962.)

8175. Gregory Industries, Inc.—Electric arc pin brazing. 19th March, 1954. (739664.)

9097. Westinghouse Electric International Co.—Electrostatic precipitators. 29th March, 1954. (739861.)

9243. Forges et Ateliers de Constructions Electriques de Jeumont.—High tension transformer windings. 30th March, 1954. (739762.)

9394. Allmanna Svenska Elektriska Aktiebolaget.—Contact device for electric resistance heating. 31st March, 1954. (739531.)

9556. Food Machinery & Chemical Corporation.—Electric pump motor. 1st April, 1954. (739537.)

9613. British Thomson-Houston Co., Ltd.—Electric lamp making machines. 1st April, 1954. (739538.)

9880. Otis Elevator Co.—Electromechanical brake control system particularly for elevators. 5th April, 1954. (739869.)

10063. Babcock & Wilcox, Ltd.—Tubulous vapour generators. 6th April, 1954. (739968.)

10150. Deuta-Werke Vorm. Deutsche Tachometerwerke Ges.—Electrical bimetallic indicating instruments. 7th April, 1954. (739969.)

10245. Parsons & Co., Ltd., C. A.—Locking devices for rotor blades of turbines and the like. 7th April, 1954. (739870.)

10540. Allgemeine Telefon-Fabrik Ges.—Selective switch for an intercommunicating telephone system. 9th April, 1954. (739873.)

10851. Foster Wheeler, Ltd.—Control of the temperature of superheated steam in water-tube boilers. 13th April, 1954. (739764.)

10948. Standard Telephones & Cables, Ltd.—Metal containers for electrical components. 14th April, 1954. (739875.)

10998. Standard Telephones & Cables, Ltd.—Radio receivers employing crystal triodes. 14th April, 1954. (739765.)

11213. Satchwell, L.—Electric heaters for liquids. 15th April, 1954. (739978.)

11368. General Electric Co.—Stabilization of electron-discharge devices. 20th April, 1954. (739981.)

(*Continued on next page*)

NEW PATENTS (*continued*)

11479. Jackson Vibrators, Inc.—Electric motor. 21st April, 1954. (739679.)

11540. Bendix Aviation Corporation.—Current regulator for dynamo-electric machines. 21st April, 1954. (739681.)

11551. Time, Inc.—Non-linear electrical control circuits. 21st April, 1954. (739683.)

11575. Drilling Research, Inc.—Electrical transmission lines. 21st April, 1954. (739684.)

11833. Mullard Radio Valve Co., Ltd.—Circuit arrangements for supplying a.c. to a utilization device. 23rd April, 1954. (739880.)

12488. British Thomson-Houston Co., Ltd.—Electric photo-flash lamp with an inside lacquer coating, and method of manufacturing same. 29th April, 1954. (739882.)

13440. Philips Electrical Industries, Ltd.—Methods of securing ceramic articles to one another or metal articles. 7th May, 1954. (739543.)

13565. Philips Electrical Industries, Ltd.—Television pick-up tubes. 10th May, 1954. (739767.)

13740. Bendix Aviation Corporation.—Magnetic amplifier. 11th May, 1954. (739884.)

14156. Electric Storage Battery Co.—Electric storage batteries. 14th May, 1954. (739772.)

14182. Standard Telephones & Cables, Ltd.—Electric pulse time modulators. 14th May, 1954. (739886). 14188. Method of forming a point contact on a wire. 14th May, 1954. (739773.)

14210. Smitsvonk N.V.—Electric ignition systems for jet engines, gas turbines, oil burner boilers and like apparatus. 14th May, 1954. (739774.) 14211. Low tension ignition system for jet engines, gas turbines, oil burners, boilers and similar installations. 14th May, 1954. (739691.)

14724. General Electric Co.—Electric water heaters. 19th May, 1954. (739779.)

14859. American Electro Metal Corporation.—Electric resistor heaters and their production. 20th May, 1954. (739780.)

15074. Hoover, Ltd.—Electric irons. 21st May, 1954. (739782.)

15077. Kolster-Brandes, Ltd.—Television receiver scanning circuits. 21st May, 1954. (739783.)

15380. Philips Electrical Industries, Ltd.—Method of manufacturing cathode-ray tubes. 25th May, 1954. (739550.)

15409. Felten & Guilleaume Carlswerk Akt.-Ges.—Electric cable. 25th May, 1954. (739551.)

15431. General Electric Co.—Heat-pump water heater. 25th May, 1954. (739552.)

15546. Radio Corporation of America.—Semi-conductor devices. 26th May, 1954. (739889.)

15547. Philips Electrical Industries, Ltd.—Method of manufacturing electric coils. 26th May, 1954. (739553.)

15818. Ateliers de Constructions Electriques de Charleroi.—Supports for magnetic heads in magnetic sound recording and reproducing equipment. 28th May, 1954. (739554.)

16162. General Motors Corporation.—Starting control devices for electric motors. 1st June, 1954. (739890.)

16296. Ford Motor Co., Ltd.—A.c. generators. 2nd June, 1954. (739557.)

16397. Du Pont De Nemours & Co., E. I.—Delay electric blasting caps. 3rd June, 1954. (739560.)

16399. Union Carbide & Carbon Corporation.—Primary galvanic battery and method of making same. 3rd June, 1954. (739990.)

16476. Metro-Cutanit, Ltd.—Thermo-electric couples. 3rd June, 1954. (739693.)

16957. General Electric Co.—Laminated cores in dynamo-electric machines. 9th June, 1954. (739992.)

16983. Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St.-Gobain, Chauny & Cirey.—Electric resistance heaters. 9th June, 1954. (739564.)

17362. Libbey-Owens-Ford Glass Co.—Electrically conducting films on bent glass. 14th June, 1954. (739565.)

17384. Compagnie Electro-Mécanique.—Methods of and means for fitting windings in stators and rotors of electric motors and the like. 14th June, 1954. (739566.)

17898. Allmanna Svenska Elektriska Aktiebolaget.—Means for voltage regulation by aid of an exciter. 18th June, 1954. (739570.) 18107. Compensating winding for electrical machines. 21st June, 1954. (739572.)

17979. Maurer Soc. Anon., Ing. A.—Cooling of electrodes of an electric oven or furnace. 18th June, 1954. (739571.)

18691. Philips Electrical Industries, Ltd.—Hybrid systems for use in radio telephony. 25th June, 1954. (739894.)

19629. Akt.-Ges. Brown, Boveri & Cie.—Thermal regulating device for turbo-generators. 5th July, 1954. (739579.)

19637. General Electric Co.—Single-phase motors. 5th July, 1954. (739580.)

20481. General Electric Co.—Fluid cooled dynamo-electric machines. 13th July, 1954. (739896.)

21045. Perrone, A., and Salvi, A.—Spacer for high voltage aerial transmission lines. 19th July, 1954. (739796.)

21137. Communications Patents, Ltd.—Radar simulation apparatus. 20th July, 1954. (739797.)

21888. Hackbridge & Hewittic Electric Co., Ltd., and Wells, R.—Motor driven device for operating a phase shifter. 27th July, 1954. (739586.)

22515. General Electric Co.—Vacuum cleaners. 3rd August, 1954. (739798.)

22963. General Electric Co.—Electromagnetic pick-off and torque motor devices. 6th August, 1954. (739589.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to the dates mentioned:—

14th October

ACE-SIL. No. 737,641, Class 9. Separators for electric storage batteries and accumulators.—American Hard Rubber Co. Address for service, c/o Haseltine, Lake & Co., 28, Southampton Buildings, Chancery Lane, W.C.2.

STATOCEM. No. 741,366, Class 9. Small electrical components and parts thereof.—Compagnie Electro Mecanique, Paris, France. Address for service, c/o Marks & Clerk, 57 & 58, Lincoln's Inn Fields, London, W.C.2.

ANKER (design). No. B739,205, Class 11. Electric lamps and lamps for vehicles.—Anker-Werke Akt.-Ges., Bielefeld, Germany. Address for service, c/o Gill, Jennings & Every, 51-52, Chancery Lane, London, W.C.2.

21st October

PIXIE. No. 737,643, Class 9. Electrical apparatus incorporating an alarm clock and electric switches, for use in making tea at a predetermined time.—British Vacuum Cleaner & Engineering Co., Ltd., Goblin Works, Ermyn Way, Leatherhead, Surrey.

PINNACLE. No. 741,607, Class 9. Scientific, electrical, radio and television apparatus, etc.—D. M. S. Toms, 9, Blenheim Court, Main Road, Sidcup, Kent.

LEOPARD. No. 741,710, Class 9. Electric welding apparatus.—Ring Motors, Ltd., Ayres Road, Old Trafford, Manchester, 16.

CREDA CORVETTE. No. 743,410. CREDA CLIPPER. No. 744,465. CREDA CAVALIER. No. 744,466, all Class 11. Electric cookers and water heaters.—Simplex Electric Co., Ltd., Broadwell, Oldbury, near Birmingham.

India's Electrical Imports

IN India's imports of electrical material during the fiscal year 1954-55 there was a decline in value of about 15 per cent on the previous twelve months. The total was Rs.270,700,000, of which Rs.157,500,000 represented machinery and Rs.113,200,000 goods and apparatus. (Rupee=1s 6d.)

The share of the United Kingdom was approximately three-fifths. Values of the principal items are shown in the accompanying table with notes of increases or decreases. It will be seen that there were declines in wires and cables (by about one-half) and in machinery, save for turbo-generator sets, while the most noteworthy increases were in imports of telegraph, telephone and radio materials, batteries and accumulators, meters and other instruments.

In assessing the future of India's electrical import trade, plans for developing power remain an important factor although downward revision seems likely for financial reasons. At the same time expansion of electrical manufacture will have its effect.

Class of Goods	1954-55 Thou. Rs.	Inc. or dec. on 1953-54 Thou. Rs.
Fans and parts	1,253	+ 570
Wires and cables	40,250	− 35,150
From U.K.	30,458	− 29,057
Telegraph and telephone instruments and apparatus	8,328	+ 3,065
From U.K.	6,871	+ 3,075
Electric lamps	328	− 30
Vacuum electric lamps	141	+ 66
Electric lamps for automobiles	23	+ 10
Bulbs for torches	1,002	− 799
From Hong Kong	580	+ 59
„ Netherlands	362	− 843
„ U.S.A.	22	+ 13
Fluorescent lamps	2,106	*
Other lamps	2,440	− 369
From U.K.	558	− 92
„ Netherlands	785	− 242
„ U.S.A.	363	+ 110
Radio apparatus	12,176	+ 333
From U.K.	5,870	− 97
„ U.S.A.	2,515	+ 319
Batteries	2,582	+ 51
Accumulators and parts	4,099	+ 2,819
From U.K.	2,754	+ 1,953
Electric condensers	940	+ 413
Electric bell apparatus	339	+ 24
Elec. lighting accessories and fittings including switches	5,031	+ 58
From U.K.	3,536	+ 403
Meters	7,084	+ 801
From U.K.	4,801	+ 1,369
„ Switzerland	829	− 157
Other electrical instruments	1,486	+ 317
Electro-medical apparatus	4,407	+ 1,064
From U.K.	699	+ 147
„ U.S.A.	1,852	+ 409
Switchboards other than telegraph or telephone	685	− 380
Electrical porcelain ware	1,203	+ 295
Elec. goods and apparatus n.e.s.	19,898	+ 2,750
From U.K.	10,365	+ 286
„ U.S.A.	3,540	+ 185
Control and switchgear	58,201	− 265
Generators, alternators and dynamos	19,608	− 21,243
Motors	13,876	− 653
Transformers	16,169	− 3,581
Turbo-generator sets	13,123	+ 5,469
Other electrical machinery	36,515	− 13,498

* New heading, comparative figures not available.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Monday, 3rd October

BIRMINGHAM.—Grand Hotel, 6 p.m. I.E.E. South Midland Centre. Chairman's address, by Lieut-Col. H. S. Davidson, followed by annual general meeting and conversazione.

ILFORD.—The Angel Hotel, 8 p.m. A.S.E.E. North-East London Branch. Film show.

HULL.—Y.E.B., Ferensway, 7 p.m. I.E.S. Leeds Centre. "Stage Lighting," by P. Corry.

LEEDS.—The Great Northern Hotel, 7.30 p.m. A.S.E.E. Leeds Branch. "Photo Electric Devices in Industry," by Mr. Hickman.

LIVERPOOL.—At the Royal Institution, Colquitt Street, 6.30 p.m. I.E.E. Mersey & North Wales Centre. Chairman's address, "Electrical Discharges in Gases," by Prof. J. M. Meek.

LONDON.—Caxton Hall, S.W.1, 7 p.m. E.P.E.A. London Technical Group. "Recent Developments in Solid Systems of H.T. and L.T. Distribution," by E. J. Whitcher.

At the Geological Society, Burlington House, W.1, 5.30 p.m. The Society of Engineers. "Electronics in Industry," by J. Cosier.

MAIDSTONE.—Wig & Gown Hotel, 6.30 for 7 p.m. I.E.E. District meeting. "Modern Developments in Atomic Energy," by Dr. T. E. Allibone.

NEWCASTLE-UPON-TYNE. —County Hotel, Neville Street, 6 for 6.30 p.m. North East Electrical Club. Annual general meeting and Presidential Address, by J. C. Byles.

SHEFFIELD.—Royal Victoria Station Hotel, 7.30 p.m. A.S.E.E. Sheffield Branch. "Power Factor Correction and Aspects of Electrical Engineering," by E. J. Haslock.

Tuesday, 4th October

BATH.—Pump Room, 7.45 p.m. Electrical Association for Women, Bath Branch. Inaugural meeting.

CARDIFF.—The Angel Hotel, Westgate Street, 7.30 p.m. A.S.E.E. South Wales Branch. Informal talk: "Theatrical Lighting Experiences," by G. W. Timms.

COVENTRY.—Technical College, 7.30 p.m. Institution of Engineering Inspection, Coventry Branch. "Fabricating for the Electrical Engineering Industry," by H. H. Reeve.

EDINBURGH.—Carlton Hotel, North Bridge, 7 p.m. I.E.E. South-East Scotland Sub-Centre. Chairman's address, by W. B. Laing.

25, Charlotte Square, 7 p.m. Incorporated Plant Engineers, Edinburgh Branch. "Feedwater Treatment."

ELTHAM.—Congregational Church Hall, Court Road, 8 p.m. A.S.E.E. South-East London Branch. "Heavy Switchgear," by J. H. Marlow.

HAMMERSMITH.—Windsor Castle Hotel, 134, King Street, 7.30 p.m. A.S.E.E. West London Branch. "The Numerous Applications of Carbon in Electrical Engineering," by A. E. Feaver.

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Centre. Chairman's address, by F. Barrell.

LEICESTER.—Grand Hotel, 7 p.m. Institution of Works Managers, Leicester Branch. Annual dinner, followed by discussion.

LIVERPOOL.—At the Royal Institution, Colquitt Street, 7 p.m. Royal Statistical Society, Merseyside Group. "Applications of Electronic Computing in Industry," by B. B. Swann.

LONDON.—At the Institution of Electrical Engineers, Savoy Place, 5 p.m. Institution of Post Office Electrical Engineers, London Centre. "Radio Aids to Marine Navigation," by W. Dolman.

At the Royal Society of Arts, John Adam Street, 7 p.m. Incorporated Plant Engineers, London Branch. "Air Pollution Problems and their Cure," by J. B. M. Mason.

Grand Hall, Caxton Hall, 9.30 a.m. Institution of Chemical Engineers. "Automatic Control in the Process Industries." Joint conference with the Society of Instrument Technology, Ltd.

Waldorf Hotel, Aldwych, 6.45 for 7 p.m. Institution of Works Managers, London Branch. Annual general meeting, followed by film show.

LOUGHBOROUGH.—The College, 6.30 p.m. I.E.E. East Midland Centre. Informal conversazione and reunion.

MANCHESTER. — Engineers' Club, Albert Square, 6.30 p.m. I.E.E. North-Western Centre. Chairman's address, by G. V. Sadler.

SHEFFIELD. — Grand Hotel, 7.30 p.m. Institution of Works Managers, Sheffield Branch. "Productivity."

STOKE-ON-TRENT. — M.E.B., Kingsway, 7 p.m. Institute of Fuel, Midland Section. "National Fuel Resources in the Light of National Fuel Requirements," by Dr. G. E. Foxwell. (Joint meeting with the North Staffordshire Fuel Society.)

Wednesday, 5th October

BOURNEMOUTH.—Grand Hotel, 7.30 p.m. Incorporated Plant Engineers, Southern Branch. "Modern Trends in Heating and Ventilating," by Col. Concannon.

EDINBURGH. — Y.M.C.A. Hall, 14, St. Andrews Street, 6.15 p.m. I.E.S. Edinburgh Centre. "Shop and Store Lighting," by R. L. C. Tate.

GLASGOW.—39, Elmbank Crescent, 7 p.m. I.E.E. South-West Scotland Sub-Centre. Chairman's address, by J. A. Aked.

HARRINGAY.—"Queen's Head," 677, Green Lanes, 7.45 p.m. A.S.E.E. North London Branch. "Modernizations and Re-equipment of British Railways," by W. N. Glossop.

LIVERPOOL.—1, Old Hall Street, 7 p.m. British Institution of Radio Engineers, Merseyside Section. "Stereophonic Sound," by R. A. Bull.

LONDON.—At the Institution of Civil Engineers, Great George Street, S.W.1, 5.30 p.m. Institute of Fuel. "The Effect of Coal Quality on the Efficiency of a Shell Boiler Equipped with a Travelling-Grate Stoker," by E. J. MacDonald and M. V. Murray.

MANCHESTER. — Engineers' Club, Albert Square, 7.30 p.m. A.S.E.E. Manchester Branch. Debate: Contracting v. Maintenance.

MIDDLESBROUGH.—Cleveland Scientific & Technical Institute, 6.30 p.m. I.E.E. Tees-Side Sub-Centre. Chairman's address, by J. Higson.

NEWCASTLE-UPON-TYNE.—King's College, College Road, 6.15 p.m. I.E.S. Newcastle Centre. Chairman's address, by J. N. K. Rankin.

PORTSMOUTH.—College of Technology Extension, Anglesea Road, 6.30 p.m. I.E.E. Southern Centre. Chairman's address, by L. H. Fuller.

PRESTON. — 49a, Fishergate, 7.30 p.m. A.S.E.E. Preston Branch. "Electronic Control in Electric Welding," by C. H. Teece.

SHEFFIELD.—Royal Victoria Hotel, 2.30 p.m. Institute of Fuel, Yorkshire Section. Chairman's address, by H. E. Pearsall.

SWANSEA.—S. Wales Electricity Board's Demonstration Theatre, The Kingsway, 6.30 p.m. I.E.S. Swansea Group. "Lighting for Sport," by M. W. Peirce.

WEST BROMWICH.—Kendrick Technical College, 7.45 p.m. Institute of Industrial Supervisors, West Bromwich Section. "Electronics in the Home," by D. A. Ellis.

Thursday, 6th October

CARDIFF.—S. Wales Electricity Board's Demonstration Theatre, The Hayes, 5.45 p.m. I.E.S. Cardiff Centre. "Lighting for Sport," by M. W. Peirce.

CHELMSFORD.—Hoffman's Social Hall, 7.30 p.m. Chelmsford Engineering Society. Presidential address, by B. N. Maclarty.

COVENTRY.—Craven Arms Hotel, High Street, 7.30 p.m. Institute of Industrial Supervisors, Coventry Section. "The Automatic Factory—A Challenge to the Supervisor," by J. B. Jay.

DUNDEE.—Queen's College, 7 p.m. I.E.E. North Scotland Sub-Centre. Chairman's address, by J. Knox.

GLASGOW.—39, Elmbank Crescent, 6.30 p.m. I.E.S. Glasgow Centre. "The Architect and the New I.E.S. Code," by A. Buchanan Campbell.

LEEDS.—Astoria Ballroom. I.E.S. Leeds Centre. Supper dance.

LONDON.—Savoy Place, 5.30 p.m. Institution of Electrical Engineers. Inaugural address by the President, Sir George H. Nelson.

MANCHESTER. — College of Technology, Sackville Street, 6.30 p.m. British Institution of Radio Engineers, North-Western Section. "Colour Television," by Dr. G. N. Patchett.

Electricity Service Centre, Town Hall Extension, 7 p.m. E.P.E.A. Manchester Technical Group. "H.V. h.r.c. Fuses," by Dr. K. Dannenberg.

NOTTINGHAM.—E.M.E.B., Smithy Row, 6 p.m. I.E.S. Nottingham Centre. Chairman's address, by P. A. Moore.

PETERBOROUGH.—Campbell Hotel, Bridge Street, 7.30 p.m. Incorporated Plant Engineers, Peterborough Branch. "Gas Turbines in Industry," by J. R. Needham.

READING.—S.E.B. Showrooms, 3, Market Place, 7 p.m. A.S.E.E. Oxford, Reading & Districts Branch. "Relays and Automatic Control in Industry," by Dr. W. L. Stern.

Friday, 7th October

ABERDEEN. — Caledonian Hotel, 6 p.m. I.E.E. North Scotland Sub-Centre. Inaugural dinner, followed by Chairman's address, by J. Knox.

LEEDS.—A.S.E.E. Leeds Branch. Visit to J. Tetley's Brewery.

LIVERPOOL. — 9, The Temple, 24, Dale Street, 7.30 p.m. A.S.E.E. Liverpool Branch. "Electric Fire Alarm System," by C. R. Mansell.

LONDON.—Park Lane Hotel, W., 7 p.m. Electrical Trades' Commercial Travellers' Association. Annual ball.

STOKE-ON-TRENT.—Electricity Showrooms, 7 p.m. I.E.E. North Staffordshire Sub-Centre. Chairman's address, by Dr. E. R. Patrick.

WEYMOUTH.—South Dorset Technical College, 6.30 p.m. I.E.E. Southern Centre. "High Speed Photography: Methods and Applications," by W. D. Chesterman.

E.A.W. Activities

A Bath Branch of the Electrical Association for Women is being formed, and the inaugural meeting will take place at 7.45 p.m. at the Pump Room, Bath, on 4th October.

The E.A.W. Stafford Branch recently celebrated its 21st birthday at a special meeting when a presentation of home workers' certificates was made by Mr. J. G. Kellie, M.Eng., M.I.E.E., of the Midlands Electricity Board. A presentation of a somewhat different kind indicated the interest which E.A.W. Branches take in electricity as an aid to the disabled, for the president, Mrs. W. H. Westhead, presented two electric blankets for the use of the blind people in Stafford. Mr. A. L. Hayes, area organizer, gave a short talk.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Ashford (Kent).—8th October. U.D.C. Street lighting equipment. (See this issue.)

Australia.—11th October. Director, Posts and Telegraphs, Melbourne. Telephone transmitter insets, mouthpieces, breast plates and contact plugs. (E.S.B. 19621/55. Ten/15637.)* 3rd November. Electrical testing instruments. (E.S.B. 20132/55. Ten/15738.)* 15th November. Multi-channel cable carrier telephone equipment. (E.S.B. 20131/55. Ten/15737.)*

14th October. Townsville Regional Electricity Board. 11,000 V switchboard. (E.S.B. 19891/55. Ten/15700.)*

Belfast.—10th October. Northern Ireland Housing Trust. Electrical installations in 27 dwellings at Groomsport and 40 dwellings at Millisle, Co. Down. Offices of the Trust, 12, Hope Street.

Bowland.—24th October. R.D.C. Electrically operated pumping plant for regional water supply scheme. A. Brooksbank, consulting engineer, General Buildings, 48, Sunbridge Road, Bradford.

Clay Cross.—28th October. U.D.C. Street lighting equipment. (See this issue.)

Dagenham.—22nd November. Corporation. Street lighting equipment. (See this issue.)

Formosa.—13th October. Central Trust of China, Taipei. Six 50 h.p. motors. (E.S.B. 19829/55. Ten/15793.)* 17th October. Electric welding equipment. (E.S.B. 19611/55. Ten/15632.)*

Heywood.—15th October. Borough Council. Two dust extraction units including electric motor, fan, electric wiring, etc. W. H. Newall, Sewage and Destructor Works, Peel Lane.

India.—7th November. Superintending Engineer, Hydel Ganga Circle, Roorkee. Transformers and coils. (E.S.B. 19105/55. Ten/15512.)*

Newbury.—27th October. Corporation. Street lighting equipment. (See this issue.)

New Zealand.—1st November. Post and Telegraph Department, Wellington. Electric fans and unit heaters. (E.S.B. 20257/55. Ten/15748.)* 2nd November. 10,000 clamps. (E.S.B. 19671/55. Ten/15665.)* 7th November. Ammeters. (E.S.B. 20255/55. Ten/15747.)*

Pakistan.—20th October. Director General of Supply and Development, Karachi. 250 MVA switchboard and 11 kV control board. (E.S.B. 20105/55. Ten/15735.)*

Portuguese East Africa.—7th November. Ports, Railways and Transport Department, Lourenço Marques. Two induction furnaces and handling plant. (E.S.B. 19980/55. Ten/15706.)* 21st November. One 100 kW diesel engine generating set with control and distribution switchboards and accessories. (E.S.B. 20003/55. Ten/15717.)* 13th December. Copper wire, insulators and spindles, crossarms and transpositions. (E.S.B. 20002/55. Ten/15725.)*

South Africa.—12th October. Stores Department, South African Railways, Johannesburg. Insulated electric cable. (E.S.B. 19760/55. Ten/15660.)*

13th October. Union Tender and Supplies Board, Pretoria. Telephone drop wire. (E.S.B. 19971/55. Ten/15686.)* Mobile engine generator sets for charging telephone batteries. (E.S.B. 19972/55. Ten/15677.)* Mains transformers and chokes. (E.S.B. 19973/55. Ten/15687.)*

14th October. Durban Electricity Department. E.h.v. joint box compound, impregnating oil and joint compounds and 11 kV cable boxes. (E.S.B. 18913/55. Ten/15775.)* Cast iron meter boxes. (E.S.B. 18911/55. Ten/15773.)* Gang-operated link switches. (E.S.B. 18912/55. Ten/15774.)*

United States.—8th November. Corps of Engineers, Portland, Ore. 13·2/115 kV and 13·2/230 kV, 63,000 kVA transformers. (E.S.B. 19817/55. Ten/15714.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Burnley.—Education Committee. Electrical installation work at Heasandford County Secondary School (£9,980).—Greenhalgh & Duxbury.

Durham.—County Education Committee. Electrical installation in Hartlepool Baltic Street County School (£1,846).—R. V. Hogg & Co., Aycliffe.

Islington.—Works Committee. Recommended. Equipment for re-lighting of Caledonian Road (£6,519).—Harland & Wolff.

Public Libraries and Museum Committee. Recommended. Replacement of the existing lighting at the West Branch Library with a fluorescent scheme (£2,271).—City Electrical Co.

Newcastle-on-Tyne. — Corporation. Recommended. Electric lighting installations in 1,015 houses at the St. Anthony's estate (£19,484).—J. & D. Ellison.

Watford.—Special Town Hall Management Committee. Recommended. Office lighting at the Town Hall (£1,951).—J. W. Russell.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Birkenhead.—Works extensions; Manganese Bronze & Brass Co., Ltd., Dock Road.

Two blocks of multi-storey flats at Oak and Eldon Streets (£300,000); borough architect, 3, Conway Street.

Bradford.—Secondary school, Rhodesway (£260,000) and junior school, Halifax Road (£54,208); city architect.

Bridgnorth (Salop).—Factory for Star Aluminium Co., Ltd.; T. W. Edwards & Sons (Audnam), Ltd., Audnam, Stourbridge.

Consett.—Factory near Consett Junction Bridge; British Oxygen Co., Ltd., Vigo Lane, Chester-le-Street.

Devonshire.—Primary schools at Fremington (£34,434) and Woodford (£62,195) and secondary schools at Ashburton (£106,534), Ivybridge (£159,217) and Tiverton (£163,296); county architect, 97, Heavitree Road, Exeter.

Eastbourne.—Twin X-ray and operating theatre suite, St. Mary's Hospital; South East Metropolitan Regional Hospital Board, 11, Portland Place, London, W.1.

Grammar school, Hampden Park; borough architect.

Gosport.—Works (£195,000); John Hunt, Ltd., builders, South Wharf, Cleveland Road.

Guildford.—Factory, Station Meadows estate; Durable Plastics, Ltd., Friary Square.

Halesowen.—Factory, Coombs Road; Hackett and Neale, Ltd., Vicarage Road, Blackheath, Birmingham.

Havant.—Works and offices; International Chemical Co., Ltd., Braydon Road, London, N.16.

High Wycombe.—Works and offices for Merritt & Hatcher, Ltd.; Y. J. Lovell & Son, Ltd., builders, Marsham Lane, Gerrards Cross.

Leicester.—First stage of community centre, Thurnby Lodge estate; city architect.

London.—Office block, 61, Cheapside; Seifert & Seifert, architects, 28, Great Ormond Street, W.C.1.

Flats (24), Lancaster Gate; E. A. Stone, Toms & Partners, architects, 28, South Audley Street, W.1.

Office block, 32, Great Portland Street; Sir Robert McAlpine & Sons, Ltd., builders, 80, Park Lane, W.1.

Londonderry.—Final stage of scheme for new general hospital for Northern Ireland Hospitals Authority; secretary to the Authority, 44/46, Queen Street, Belfast.

Macclesfield.—Cinema, Thomas Street and Great King Street; Associated British Cinemas, Ltd., 30/31, Golden Square, W.1.

Merstham.—R.C. church, Weldon Way; Alleyn & Mansel, architects, Victoria Chambers, High Street, Crawley.

Midhurst.—Dwellings (34), Rogate and Terwick; T. Greenfield, architect, Newstead.

Nantwich.—Proposed factory; London Central Meat Co., Ltd., 296, High Street, Bangor.

Northwood.—Buildings for London College of Divinity (£190,000); G. E. Wallis & Sons, Ltd., builders, 231, Strand, London, W.C.2.

Nottingham.—Large extensions at University; G. A. Jellicoe, architect, 12, Gower Street, London, W.C.1.

Plymouth.—Block of offices, Armada Way; General Accident Fire and Life Assurance Corporation, Ltd., Highfield, Tavistock Road, Hartley, Plymouth.

Preston.—Reconstruction of works for Goss Printing Press Co., Ltd.; Harry S. Fairhurst & Son, architects, 55, Brown Street, Manchester.

Salford.—Rebuilding paper mills, Broughton Bridge (£300,000); Olive and Partington, Ltd., paper manufacturers, Turn Lee Mills, Glossop.

Sunderland.—Clothing factory additions, Back Sea View Street, for Jackson and Associated Manufacturers, Ltd.; Stephenson, Gillis and Partners, architects, North Street, Newcastle-on-Tyne.

New "Moorlands" Secondary Technical School for Boys, Castle View Modern School, and Broadway Modern School; H. C. Bishop, borough architect, Grange House, Stockton Road.

Reconstruction of factory at Southwick after fire; Alton & Co., Ltd., piping manufacturers.

Swansea.—Factory, Gorseinon estate; Jonah & Arnold Smith, architects, Great Western Chambers, Neath.

Hostel at Swansea Training College (£65,000); R. Hudson, borough surveyor, Guildhall.

Welwyn Garden City.—Large extensions to factory (£500,000); Ardath Tobacco Co., Ltd., Worship Street, London, E.C.2.

Wood Green.—Extensions to Sumara Works, Albert Road, for Ramus Tile Co., Ltd., Albert Road, N.22; H. Cullerne Pratt, architect, 399, High Street, Stratford, E.15.

Workington.—Extensions to factory for Workington Rayon Mills, Ltd.; Ronald Ward & Partners, architects, 29, Chesham Place, Belgrave Square, London.